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COMPARATIVE ZOÖLOGY,

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* * *

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No. 20,512
April 23, 1903

A MANUAL

OF

MARINE ZOOLOGY

FOR

The British Isles.

BY

PHILIP HENRY GOSSE, F.R.S.

> "This great and wide sea, wherein are things creeping innumerable, both small and great beasts. . . . . There is that Leviathan, whom Thou hast made to play therein."—*Ps.* civ. 25, 26.

PART II.

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PREFACE

TO PART II.

THE publication of the First Volume of this Work has elicited so many testimonies to its usefulness, as to satisfy me that I had not erred in supposing that such a book was needed. I now introduce the Second (and final) Volume, hoping that it may be received with as much favour as its predecessor.

By a most singular coincidence, the number of figures in this volume is exactly the same as in the former, viz. three hundred and thirty-nine; and as each genus is illustrated, we see that so far as our present knowledge goes, those genera of our Marine Fauna, which belong to the Radiate and Annulose forms, exactly equal in number those of the Mollusca and Vertebrata.

Of these three hundred and thirty-nine figures, two hundred and thirty-two are original, one hundred being drawn from living (or, in the case of Fishes, from fresh) specimens, and one hundred and thirty-two from such as are preserved, either dry or in spirits. The list at the end of the volume will show the authorities from which I have copied the remaining one hundred and seven.

I have added a Supplement to the first volume, supplying some omissions, and bringing it up to the present state of our knowledge.

P. H. G.

London, *August*, 1856.

MARINE ZOOLOGY.

SUB-KINGDOM IV. MOLLUSCA.

CLASS I. POLYZOA.

IT has been usual, in our systematic books on Zoology, to include the POLYZOA (or BRYOZOA, as they are sometimes termed) in the Class ZOOPHYTA. And truly, if we considered only their general external appearance, this would seem their most natural alliance. Universally of microscopic minuteness, growing parasitically on submerged foreign bodies, as shells, rocks, and sea-weeds, springing (most of them at least) from a creeping root-thread, in the form of a tiny shrub, composed of successive series of pellucid cells, from which protrude animals, each surmounted by a coronet of radiating tentacles, all connected organically in a compound life,—these creatures do present, it must be confessed, very many characters in common with the *Sertulariadæ* and other Hydroid Polypes.

Yet when we examine the animals themselves, we find them organized on a much higher type than the Polypes, viz., on that which exists in the Mussel and the Oyster, though in its most simple condition of development. If we take one of the calcareous-celled species, *Scuparia chelata*, for example,* which is a fair type of the Class, we find an animal living freely in its cell, with whose walls† it is connected only by means of muscle-bands and threads, at certain points, and by the covering of the mouth of the cell. This covering is membranous, and is capable of great protrusion; the animal, in the process of expansion, pushing out a doubling of the membrane, like the turning inside-out of a stocking. The animal has a receiving orifice or mouth, surrounded by a crown of tentacles, and leading into a sensitive and contractile gullet, into which the food is gorged; thence it passes into a capacious crop, and afterwards into a muscular gizzard; to this succeeds a duct leading into a digesting stomach, whence a long intestine passes upward, emerging by a discharging orifice close to the receiving one.

This highly developed digestive system is characteristic of the Class, as well as this course which it follows—a line bent upon itself; the only deviation of importance being that, in some genera, the muscular gizzard is either wanting or indistinctly developed.

The tentacles differ importantly from those of the Polypes. Instead of being soft, fleshy, highly contractile, and studded with knots of nettling-capsules, they are straight, somewhat stiff, slender threads, incapable of contraction, and set, on their two opposing sides, (viz., on those sides which face the next tentacles,) with long cilia, the action of which is to produce a strong current up one side and down the other of each tentacle. The united effect of these currents as a whole is a powerful vortex, the centre of which is the mouth at the bottom of the belt of tentacles; and thus floating particles of food, or living animalcules, are drawn into the whirlpool, and presently engulphed in the yawning gullet below.

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* Figured and described in detail in my "Devonshire Coast," p. 132, by the name of *Eucratea chelata*.

† Perhaps it would be more correct to say, with a vascular coat which lines the walls of the cell.

When alarmed, the animal contracts its muscular threads and retires within its cell, the protrusile membrane being drawn inwards, and the tentacles closing into a compact bundle as they descend.

Though there is little diversity in the form or structure of the animals themselves in this Class, there is much difference in the form, arrangement, and composition of the cells. In general the form is ovate or oblong; but this general shape is variously modified, being tubular, club-shaped, horn-shaped, cradle-shaped, square, three-sided, rhomboidal, &c., &c. The arrangement is often shrub-like; but when so, the branches may be formed by a single series of cells, or of two or more set side by side, or back to back, or both. At other times the branches are creeping and adherent, as well as the root-thread; or the cells may be arranged in close series without branch or root-thread, either adhering in irregular patches, as the *Lepraliæ*, or rising into broad flexible leaves, as the *Flustræ*, or in solid stony walls as the *Escharæ*. The cells may be horny or membranous, with the calcareous element not deposited, as the *Vesiculariadæ;* or they may be sunk in a common fleshy or cartilaginous mass, as the *Alcyonidiadæ*. Finally, the cell may be wanting, or, at least, inseparable from the skin, as in the genus *Pedicellina*.

Many of the genera are furnished with accessory organs, which appear to be analogous in office to the *pedicellariæ* of the Starfishes and Urchins. From the remarkable resemblance which (in many species) these appendages bear to the head of a vulture, they have been commonly called "Bird's-head processes" (*avicularia*). They are usually jointed to some part of the cell, the head moving on the joint freely as on a hinge, nodding to and fro, occasionally opening widely the mandibles, and closing them with a powerful snap, apparently with great exercise of will and discrimination. Ingenuity has been exercised in vain to divine the use of these singular processes, which seem to be so little connected organically with the animal within the cell, that the latter may be quite dead and even decayed away, while the bird's-head maintains its vivacity unimpaired.

It has long been suspected that these organs are in some way or other useful in the procuring of food, and several observers have noticed the seizure of small roving animals by the pincer-like beaks; hence it has been too hastily concluded that such victims become the food of the Polyzoan. But it seems to have been forgotten, not only that these organs have no power of passing the prey thus seized to the mouth, but also that this latter is situated at the bottom of a funnel of ciliated tentacles, and is calculated to receive only such minute prey as is drawn within the ciliary vortex. I have ventured to suggest a new explanation. The seizure of a passing animal, and the holding of it in the tenacious grasp until it dies, may be a means of attracting the proper prey to the vicinity of the mouth. The presence of decomposing animal substance in water invariably attracts crowds of infusory animalcules, which then breed with amazing rapidity so as to form a cloud of living atoms around the decaying body, quite visible in the aggregate to the unassisted eye, and these remain in the vicinity, playing round and round until the organic matter is quite consumed. Now, a tiny Annelid or other animal, caught by the bird's-head of a Polyzoan and tightly held, would presently die; and though in its own substance it would not yield any nutriment to the capturer, yet by becoming the centre of a crowd of busy Infusoria, multitudes of which would constantly be drawn into the tentacular vortex and swallowed, it would be ancillary to its support, and the organ in question would thus play no unimportant part in the economy of the animal.

Besides the birds'-heads (*avicularia*), some species are furnished with long slender *whip*-like spines (*vibracula*), likewise moving freely on a hinge-joint, and apparently serving to rid the animal of intruding vagrants, and to cleanse away accidental defilement, by sweeping across the orifice of the cell. Both these kinds of organs, by their presence or absence, their form, position, &c., furnish aids to the determination of genera.

The entire assemblage of cells springing from one root-thread, or originating from a single cell, is called the *polyzoary*.

The reproduction of the species, so far as it has been yet observed, is by means of *ovules*, or soft eggs, generated within special cells, which are ordinarily situated on the summit of a dwelling-cell. The egg when discharged resembles an infusory animalcule, being a minute opaque body, covered with vibratile cilia, by whose action it is rapidly rowed to a resting-place. Here it adheres, and quickly develops a cell, with its indwelling animal, whence others grow in the order of arrangement proper to its kind.

Localities, &c.—Some few of the encrusting kinds, as *Tubulipora patina*, and the *Membraniporæ*, and some of the fleshy kinds, as *Sarcochiton*, &c., spread on the surface of living sea-weeds. The more ordinary support for the former is some old shell or loose stone in deep water; but not a few select indifferently these or the surface of the solid rock. The branched sorts, whether creeping or erect, are found on the stems of growing sea-weeds, within tide-marks and in deep water, as well as on inorganic substances. The tiny whitish shrubs of many species are among the most interesting as well as the most familiar objects with which the searcher for marine animals is conversant.

Identification.—The principal points to be observed are the following:—The form of the tentacle-bell; the presence of a lip to the cell; the connexion of the cells, whether by joints or adhesion; the arrangement of the cells, in one or more rows; the texture of the cells; the presence and number of *birds'-heads* or *whips;* the form of the egg-cells and their position; the shape of the cell; the shape of its aperture; the presence of spines.

Authorities.—Mr. Busk's admirable "Catalogue of Marine Polyzoa in the British Museum," supersedes every other so far as it has yet been published, viz., to the end of the CHEILOSTOMATA. For the rest, I am indebted to the second part of the "History of British Zoophytes," by the late Dr. Johnston, and to my own observations.

POLYZOA.

Molluscous animals enclosed in cells, organically associated, and originating from a single cell; digestive system provided with a receiving and a discharging orifice, placed near together; mouth surrounded by ciliated tentacles; reproduction by ciliated free-swimming ovules.

Order I. INFUNDIBULATA.

Tentacles forming an uninterrupted funnel-shaped crown around the mouth. Exclusively marine.* (Order II. *Hippocrepia*, consists exclusively of fresh-water species.)

Cell with a round simple orifice	*Cyclostomata.*
Cell-orifice filled with a thin, membranous, or calcareous plate, with a curved mouth, furnished with a moveable lip	*Cheilostomata.*
Cell-orifice surrounded by a fringe of bristles (more or less developed) when the animal is protruded	*Ctenostomata.*

Sub-Order I. CYCLOSTOMATA.

Polyzoary calcareous, massive, circular, lobed, or divided dichotomously; cells long and tubular, with a round, prominent, unconstricted orifice	*Tubuliporadæ.*
Polyzoary plant-like, jointed, branched; cells tubular, disposed in one or two series, with round orifices looking to opposite sides	*Crisiadæ.*

FAMILY I. TUBULIPORADÆ.

Tubulipora (Lamk.). Wart-like, with a defined base; cells sub-erect, aggregated, or in imperfect rows, more or less free at the tip.

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* With the exception of *Paludicella articulata*, a species found in the loughs of Ireland, which appears to belong to this Order.

§ 1. With a thin sessile cup-like base.

T. patina. Fig. 1 ; *n. s.*
hispida.

§ 2. With a lengthened or thickened base.

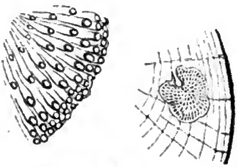
T. penicillata.
truncata.

§ 3. Lobed, with an unmargined base.

T. lobulata.
phalangea.
flabellaris.

T. serpens.
hyalina.

1



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Diastopora (Lamx.). Encrusting, undefined; cells alternating, tubular, horizontal, immersed, with a raised circular orifice.

D. obelia. Fig. 2 ; *n. s.* and *mag.*

Idmonea (Lamx.). Divided dichotomously, erect; cells only on one side, tubular, in transverse rows, divided into two sets by a medial longitudinal line.

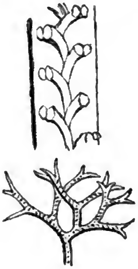
I. atlantica. Fig. 3 ; *n. s.* and *mag.*

Pustulipora (De Blainv.). Erect, cylindrical; cells semi-immersed, opening all round, with a prominent orifice.

P. proboscidea. Fig. 4 ; *n. s.* and *mag.*
deflexa.

Alecto (Lamx.). Creeping, adherent, irregularly branching; cells horizontal, in one or more linear series, with their extremities free.

A. granulata.
major.
dilatans. Fig. 5; *n. s.* and *mag.*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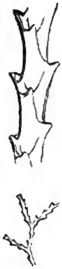
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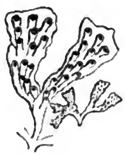
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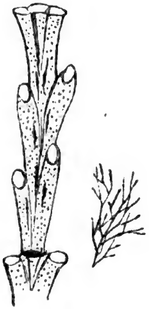
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FAMILY II. CRISIADÆ.

Crisia (Lamx.). Cells in two rows, sub-alternate; the orifice entire and terminal.

C. eburnea.
denticulata. Fig. 6; *n. s.* and *mag.*
aculeata.
geniculata.

Crisidia (M.-Edw.). Cells in a single row; the extremities free, diverging.

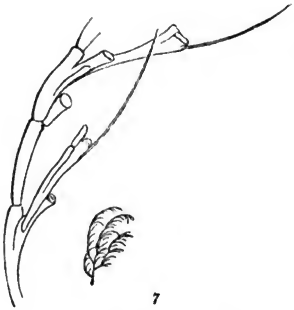
C. cornuta. Fig. 7; *n. s.* and *mag.*
setacea.

Sub-Order II. CHEILOSTOMATA.

Polyzoary divided into distinct portions or joints by flexible articulations . . . *Articulata.*
Polyzoary continuous and unjointed . . *Inarticulata.*

TRIBE I. ARTICULATA.

Polyzoary branched, erect; branches cylindrical, with the cells arranged on all sides	*Salicornariadæ.*
Polyzoary branched, erect; branches flat, linear, with the cells on the same plane	*Cellulariadæ.*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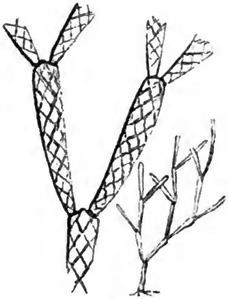
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FAMILY I. SALICORNARIADÆ.

Salicornaria (Cuv.). Surface divided into lozenge-shaped spaces, by ridges surrounding the cells.

S. farciminoides. Fig. 8; *n. s.* and *mag.*

FAMILY II. CELLULARIADÆ.

Cellularia (Pall.). Cells in two or three rows; more than four between two joints, contiguous, perforated behind; no bird's-head nor whip.

C. Peachii. Fig. 9; *n. s.* and *mag.*

Menipea (Lamx.). Cell oblong, tapering downwards, not perforate behind; one or two birds'-heads in front below the aperture.

M. ternata. Fig. 10; *n. s.* and *mag.*

Scrupocellaria (Van Beneden). Cell with a whip behind, and a sessile bird's-head at the upper and outer angle; aperture spinous.

S. scrupea.
scruposa. Fig. 11; *n. s.* and *mag.*

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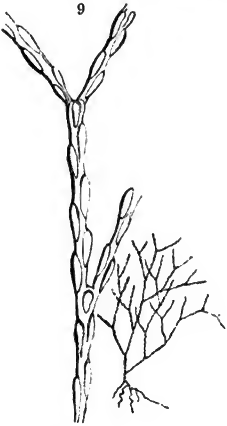

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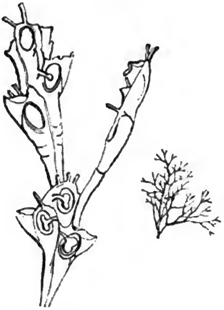

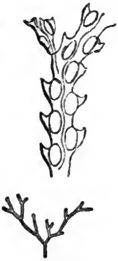

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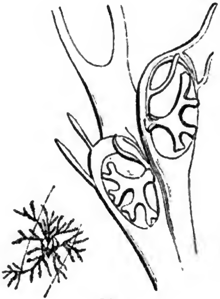

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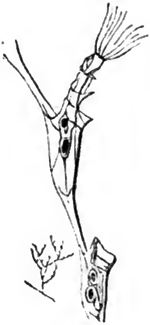
Canda (Lamx.). Cell with a whip in a notch in the outer side; no bird's-head on the angle.

C. reptans. Fig. 12; *n. s.* and *mag.*

TRIBE II. INARTICULATA.

Cells in one series	*Scrupariadæ.*
Cells in more than one series:—	
Cells opposite, in pairs	*Gemellariadæ.*
Branches narrow; cells in two series or more—	
Whips or birds'-heads at the back	*Cabereadæ.*
No whips; birds'-heads jointed	*Bicellariadæ.*
Expanded, foliaceous, flexible, erect	*Flustradæ.*
Expanded, encrusting, stony; cells horizontal, in quincunx	*Membraniporada*
Massive, globose, encrusting, or erect, stony; cells vertical to the common plane, irregularly heaped together	*Celleporadæ.*
Expanded and leafy, or branching, stony; cells in the same plane, in quincunx	*Escharadæ.*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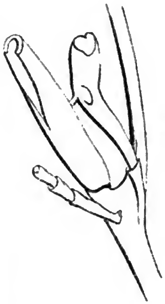
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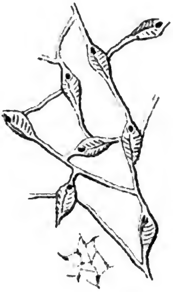
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FAMILY I. SCRUPARIADÆ.

Scruparia (Oken). Erect, branching; cell horn-shaped, simple; aperture obliquely terminal.

S. chelata. Fig. 13; *n.s.* and *mag.*

Salpingia (Coppin). Erect, branching; cell elongated, its base furnished with spines and trumpet-shaped processes; aperture lateral.

S. Hassallii. Fig. 14; *mag.*

Hippothoa (Lamx.). Creeping, adhering; branches springing from the sides of the cells.

H. catenularia.
divaricata. Fig. 15; *n. s.* and *mag.*

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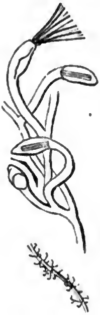

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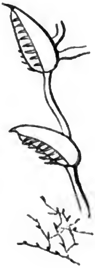

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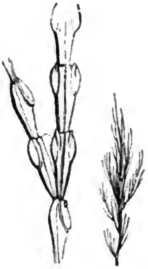

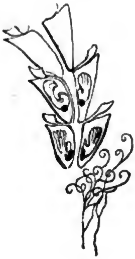

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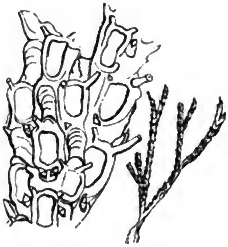

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Ætea (Lamx.). Base a creeping, adhering thread; cells tubular, erect, scattered.

Æ. anguina. Fig. 16; *n. s.* and *mag.*
truncata.

Beania (Johnst.). Base a creeping, adhering, branching thread; cells sessile, erect, scattered, with a double spinous keel on one side.

B. mirabilis. Fig. 17; *n. s.* and *mag.*

FAMILY II. GEMELLARIADÆ.

Gemellaria (Sav.). Cells joined back to back, all the pairs facing the same way; aperture oval, oblique; no birds'-heads.

G. loricata. Fig. 18; *n. s.* and *mag.*

Notamia (Flem.). Each pair of cells arising from the next pair but one below it, by tubular prolongations; tobacco-pipe-shaped birds'-heads above each pair.

N. bursaria. Fig. 19; *n. s.* and *mag.*

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FAMILY III. CABEREADÆ.

Caberea (Lamx.). Cells (in the Brit. sp.) two or three rowed; branches furnished behind with many large whips, placed obliquely in two rows.

C. Hookeri. Fig. 20; *n. s.* and *mag.*

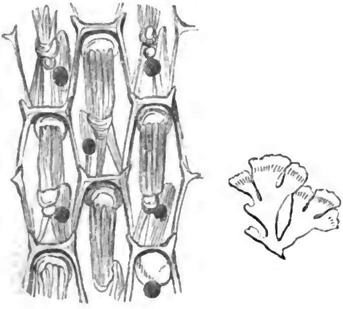
FAMILY IV. BICELLARIADÆ.

Bicellaria (De Bl.). Cells top-shaped, distinct, armed with spines; aperture looking upwards.

B. ciliata. Fig. 21; *n. s.* and *mag.*

Bugula (Oken). Cells elliptical, closely contiguous, in two or more rows; aperture very large; margin simple, not thickened; birds'-heads (generally present) stalked and jointed.

B. neritina.
flabellata.
avicularia. Fig. 22; *n. s.* and *mag.*
B. plumosa.
Murrayana.



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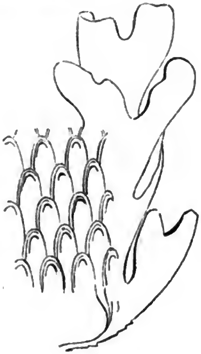

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FAMILY V. FLUSTRADÆ.

Flustra (Linn.). Cells contiguous, on both sides of the expansion.

F. foliacea.
papyracea. Fig. 23; *n. s.* and *mag.*
F. truncata.

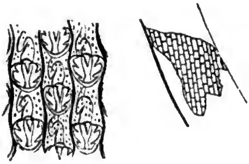
Carbasea (Gray). Cells contiguous, on one side only.

C. papyrea. Fig. 24; *n. s.* and *mag.*

FAMILY VI. MEMBRANIPORADÆ.

Membranipora (Johnst.). Cells open in front, with raised margins; usually encrusting sea-weeds, more rarely shells and stones.

M. membranacea.
  pilosa. Fig. 25; *n. s.* and *mag.*
  coriacea.
  lineata.
M. Flemingii.
  Rosselii.
  Lacroixii.
  monostachys.



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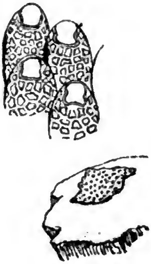

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Lepralia (Johnst.). Cells closed in front, spreading from the centre outwards.

N.B. The British species of this genus, which are very numerous, are thus subdivided by Mr. Busk:—

* Furnished with birds'-heads.

a. Bird's-head medial and single.
  a. Above the mouth.
    L. Brongniartii.
  b. Below the mouth.
    L. Landsborovii.
      reticulata.
      auriculata.
    L. concinna.
      verrucosa.
      violacea.

β. Birds'-heads double; or if single, on one side.
    L. spinifera.
      trispinosa.
    L. coccinea.
      linearis.

** Furnished with whips.

L. ciliata.
Gattyæ.
Hyndmanni.

*** With neither birds'-heads nor whips.

a. The mouth armed with spines.

L. variolosa.
nitida.
annulata.
bispinosa.
Peachii.

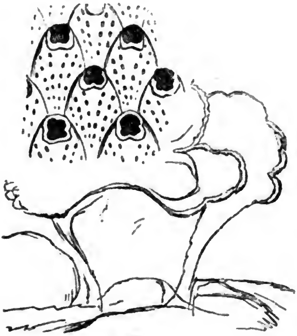
L. ventricosa.
melolontha.
innominata.
punctata.

β. The mouth unarmed.

L. figularis.
pertusa.
Pallasiana. Fig. 26 ; *n. s.* and *mag.*
labrosa.

L. simplex.
Malusii.
granifera.
hyalina.

27



28

FAMILY VII. CELLEPORADÆ.

Cellepora (Fabr.). Cells vase-like, with a beak on one or both sides, furnished with a bird's-head.

* Compact.

C. pumicosa. Fig. 27 ; *n. s.* and *mag.*
Hassallii.
vitrina.

** Branching.

C. ramulosa.
Skenei.

Family VIII. Escharadæ.

Eschara (Ray). Cells on both surfaces of the expansion, immersed, and coalescent.

E. foliacea. Fig. 28 ; *n. s.* and *mag.*
cervicornis.

Retepora (Lamk.). Leafy, reticulated; cells immersed, on one surface only.

R. cellulosa. Fig. 29 ; *n. s.* and *mag.*
Beaniana.

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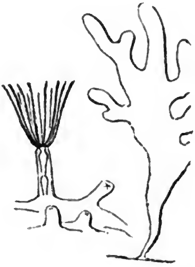

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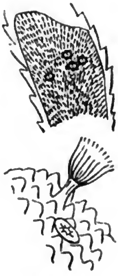


31

Sub-Order III. CTENOSTOMATA.

Polyzoary sponge-like, fleshy, irregular in sharpe; cells immersed, with a contractile orifice . . . . *Alcyonidiadæ.*

Polyzoary plant-like, horny, tubular ; cells free, deciduous ; the extremity flexible and invertile . . . . *Vesiculariadæ*

Polyzoary plant-like, creeping, adherent, sending up at irregular intervals free, erect, stalked polypes, without distinct cells . . *Pedicellinadæ.*

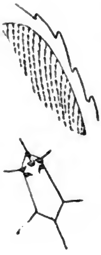
FAMILY I. ALCYONIDIADÆ.

Alcyonidium (Lamx.). Erect, lobed, or simple; cells immersed, five-angled.

A. gelatinosum. A. parasiticum.
hirsutum. Fig. 30; *n. s.* and *mag.*

Cycloum (Hassall). Encrusting, covered with imperforate warts; eggs in circular clusters.

C. papillosum. Fig. 31; *n. s.* and *mag.*



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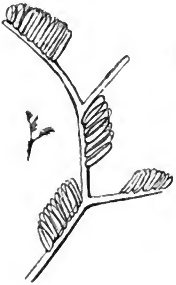

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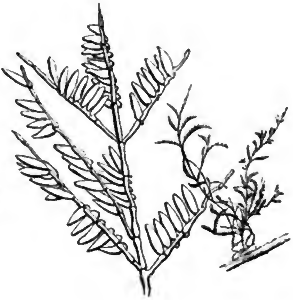

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Sarcochitum (Hass.). Encrusting, covered with perforate prominences, in which the cells are immersed; eggs scattered singly throughout.

S. polyoum. Fig. 32; *n. s.* and *mag.*

FAMILY II. VESICULARIADÆ.

Amathia (Lamx.). Shoot slender, thread-like, erect, branched; cells tubular, mutually adherent, set on one side only, in a single row, the rows separated by blank intervals; animals with eight tentacles.

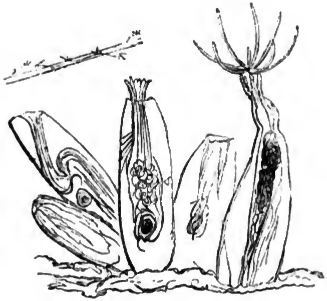
A. lendigera. Fig. 33; *n. s.* and *mag.*

Vesicularia (Thomps.). Shoot branched, jointed; cells oval, separated, on one side, in one row; animals with eight tentacles and a gizzard.

V. spinosa. Fig. 34; *n. s.* and *mag.*

Valkeria (Flem.). Variously branched; cells oval, clustered irregularly; animals with eight tentacles, no gizzard.

V. cuscuta. Fig. 35; *n. s.* and *mag.*
uva.
pustulosa.



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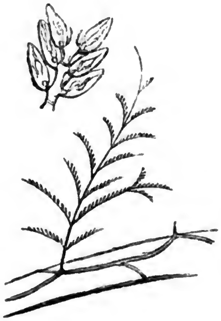

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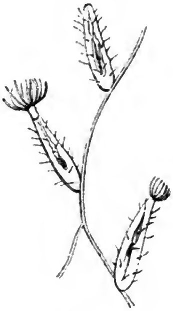
Mimosella (Hincks). Variously branched; cells ovate, set in two rows, opposite, with a joint at the base, on which they can move to and fro, and fold together on the branches; animals with eight tentacles and a gizzard.

M. gracilis. Fig. 36; *n. s.* and *mag.*

Avenella (Dalyell). Slender, thread-like, creeping, nearly simple; cells large, solitary, irregularly scattered, set in a single row, slightly contracted at the top, curved; animals with from twenty to twenty-four tentacles, and a small gizzard.

A. Dalyellii. Fig. 37; *mag.*

Nolella (Gosse). Cells erect, sub-cylindrical, crowded on tubes which form an undefined encrusting mat; animals with eighteen tentacles, forming a bell.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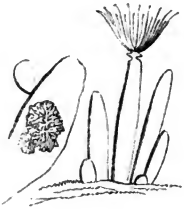
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N. stipata. Fig. 38; *n. s.* and *mag.*

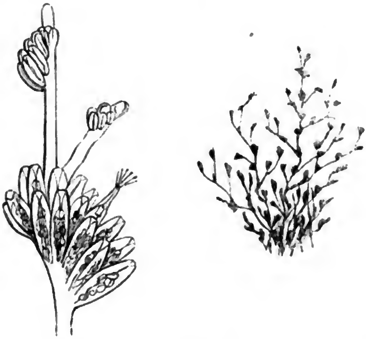
Bowerbankia (Farre). Matted and creeping, or erect and irregularly branched; cells tubular, densely clustered; animals with eight to ten tentacles, and a strong gizzard.

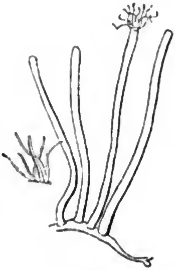
B. imbricata. Fig. 39; *n. s.* and *mag.*

Farrella (Ehr.). As *Bowerbankia*, but the animals with twelve to thirty tentacles, and no gizzard.

F. repens.
elongata.
gigantea. Fig. 40 ; *n. s.* and *mag.*

39





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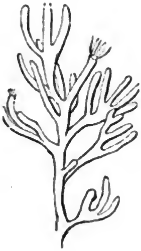

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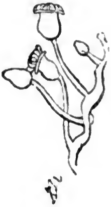

42

Anguinella (Van Ben.). Branched in a palmate manner, one tube springing out of another, largely composed of mud ; animals with twelve tentacles and no gizzard.

A. palmata. Fig. 41 ; *mag.*

FAMILY III. PEDICELLINADÆ.

Pedicellina (Sars). Animal globose, with a circle of short tentacles, which are curled up inwardly, and are not retractile; placed at the summit of an erect slender stalk, which springs from a creeping, adherent thread.

P. echinata.
  Belgica. Fig. 42; *n. s.* and *mag.*
  gracilis.

CLASS II. TUNICATA.

(ASCIDIANS.)

THE relationship between the animals of the Class just dismissed and those of the present is close and obvious. The cell of the *Polyzoan* is represented in the *Ascidian* by the *test* or *tunic*, an envelope of cartilaginous, leathery, fleshy, or membranous consistence, having two orifices. Within the *test* is another envelope, distinguished as the *mantle*, having two orifices corresponding to those of the *test*. The true digestive stomach is situated at a great distance from the receiving orifice, and near the bottom of the cavity of the body, whence (in the majority of cases) the intestine, bending abruptly upwards, terminates in the secondary orifice, a little on one side of the primary (or receiving) one.

Thus far the parallelism is very close with the POLYZOA. There are, however, important deviations from the structure proper to that Class. The crown of radiating tentacles, richly ciliated, is here represented by minute rudiments, the slight importance of which is indicated by their being common to both apertures in some species, and absent from both in others; while the elaborate array of cilia, which performs so essential a part in the function of respiration, appears under quite another form. The lengthened gullet and crop leading to the stomach in the POLYZOA, is here dilated so as to form a sac of still more enormous dimensions, the whole internal surface of which is covered with vibrating cilia, while the sac itself is composed of a tissue of blood-vessels, crossing each other at right angles, so as to form a muslin-like fabric of exquisite fineness.

In order to understand the relation of this respiratory sac with the breathing apparatus of the POLYZOA, it seems to me that we have only to suppose the tentacles (which are, doubtless, the blood-vessels of the latter) turned into the gullet, and spread over its interior surface, giving off a number of cross branches, uniting the whole into a network;—and we have essentially the sac of the *Ascidia.*

Few microscopic spectacles are more interesting than the sight of the circulation of the blood along the network of this exquisite tissue, and that of the ciliary waves by which the circulating fluid is revivified. In the transparent species, such as *Clavelina, Perophora,* &c., both phenomena are seen to great advantage. The effect of the reticulation is to divide the whole surface of the sac into oblong or oval spaces, set in regular rows; which spaces, being formed by the modified tentacles with their ramifications, bear the cilia on their circumferences. The optical effect of vibrating cilia is, as is well known, an appearance of dark teeth chasing each other; and in this case we seem to see a vast number of oblong or oval rings, set in orderly arrangement, each composed of a circular series of these running teeth, like the cogs on the crown-wheel of a watch, chasing each other round and round, with an even, moderately rapid, incessant pursuit.

At the same time, between the oval spaces—that is, within the vessels,* which by their reticulation make the spaces—the blood-globules wind along, moving by jerks as impelled by the pulsations of a heart set in a distinct cavity below the lower extremity of the breathing sac. This blood-circulation is intermittent in duration, and reversible in its course. For instance, in *Perophora*, after about a hundred regular pulsations, during which the blood-globules have been uniformly driven *from left to right*, suddenly the heart ceases to beat, the globules rest in their course, and all is still. In a few seconds the pulsations begin again, and proceed with as much regularity as before; but the course of the circulation is reversed,—it is now *from right to left.*

The stomach in this Class is a dilatation or chamber of the alimentary canal, the surface of which is surrounded by a glandular mass, performing the functions of a liver: the bile secreted by the latter finds its way into the stomach through perforations in its walls. The intestine does not reach to the exterior of the animal, but terminates loosely in a cavity which opens by the secondary orifice. Not only the remains of the digested food, but also the eggs, find their way out through this aperture. I have seen the globular crimson eggs of the little *Cynthia grossularia* shot out from this orifice to the number of a dozen or more in succession, and with a propellent force that carried them up perpendicularly to a height equal to ten times that of the animal.

So far as is known, the sexes are united in the same individual.

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* Rather grooves, or open canals, and not true tubular vessels.

The young animal in this Class passes through a metamorphosis. At first it has a tadpole-like form, with a long flattened tail, which is an efficient swimming organ. Button-like warts bud out from the fore part, by which the infant Tunicate presently cements itself to some fixed body; soon after which the tail is absorbed, and the adult form is assumed.

The nervous system is represented by a single ganglion, situated beneath the mantle between the two orifices. Nerves pass from this centre to various parts of the body, and to the organs of sense. The most distinct of these latter are the eyes and the tentacles. In many species we see eight red specks placed around the margin of the receiving orifice, and six around the discharging one. These are eyes, which possess (according to Krohn and other anatomists) all the parts necessary for distinct vision, viz., the sclerotic coat, cornea, pigment, iris, tapetum, vitreous humour, crystalline lens, retina, and optic nerve.

Fixed and almost motionless as most of the TUNICATA are, during life, the muscular system is little developed in them. In general it consists of a few circular and longitudinal bands, the chief operation of which is the spasmodic enlargement or contraction of the body-cavity at certain intervals, by which the surrounding water is emitted or ejected. The opening and closing of the orifices are, in most cases, the only voluntary movements that can be detected in these sluggish animals.

Some modifications under which the TUNICATA present themselves to us require to be noticed. Many of the forms are compound, such as the *Botrylli;* those little patches of firm jelly which we find between tide-marks, adhering to sea-weeds or to stones, of various gay colours, set with minute stars of brighter hues. These stars, or *systems*, of which there may be many in a single patch, are composed of minute TUNICATA, set in a radiating circle, and marked by this peculiarity; that instead of the two orifices being placed close together, as usual, the receiving one alone is directed outwards, the discharging one opening at the opposite extremity into a common circular reservoir, which is the outlet of that particular system.

In other cases the animals are united into compound systems, enveloped in a common mass; but the form of each animal is that already described, each having its own discharging orifice placed near the receiving one. These compound encrusting forms show a relation to the *Alcyonidiadæ* among the POLYZOA.

There are other genera, again, which consist of animals individually distinct, and of the ordinary structure, but which spring singly from a common creeping root-thread. These (*Clavelinadæ*) present the most close analogy with the condition of the *Vesiculariadæ*, and particularly of *Pedicellina*.

Though the general habit of this Class is to be permanently fixed to foreign bodies, yet there are some members of it which are free. The genus *Pelonæa* appears to have a form, structure, and habits, which bring it into proximity with some of the worm-like ECHINODERMATA. "They present the remarkable positive anatomical character of an union of *mantle* with *test*." *

In this latter character they are paralleled by the still more free *Salpadæ*, creatures which differ very widely from the ordinary conditions of their relatives. They are chiefly tropical and oceanic animals, swimmers in the wide and open sea, visiting our coast so rarely that we can scarcely reckon them as properly British animals. Hence I shall but briefly notice their more obvious peculiarities.

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* Forbes and Hanley; Br. Moll. i. 42.

These creatures are found sometimes solitary, at others united in long chains composed of numerous individuals alike in form and structure, each an independent being, though constantly associated, and linearly aggregated with its companions. These long chains swim through the water with regular serpentine movements, the result of the combined reception and discharge of water by the whole group. When lifted from the water, the links of the chain fall asunder, the several animals of which it is composed losing their power of adhesion.

The solitary Salpæ are very dissimilar from these in form and structure, and are never found united in chains. They were, therefore, supposed to be distinct species; but the discovery was made by Chamisso, that both the one and the other formed but parts of the perfect type of a single species. The progeny of the Chain-Salpa is a solitary Salpa, and that of the solitary Salpa is a Chain-Salpa, according to the law of "Alternation of Generations," which has already been mentioned as prevailing among the ZOOPHYTA and the ACALEPHA.*

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* Professor Huxley contends that the true expression of the phenomena is as follows:—The Chain-Salpa alone produces a true embryo by proper generation, which becomes a solitary Salpa; this, by a process of gemmation, produces a "bud," or "stolon," which, under the form of a Chain-Salpa, is "nothing more, homologically, than *a highly individualized generative*

Localities, &c.—The *Botrylli* and some other of the encrusting genera are found on stones, and on the surface of the rocks, but more commonly on the broad fronds of *Fuci*, and other sea-weeds, and more abundantly near low-water mark than in deep water. Others of the compound races, as *Amœrœcium*, chiefly affect the sides of perpendicular or overhanging ledges, the sides of caverns, and similar dark situations. The *Clavelinadæ* generally occur in little pools. The *Ascidiæ* usually adhere to stones and old shells, as do the *Cynthiæ*, &c.; but some of the smaller kinds adhere to sea-weeds. When the *Ascidiæ* are found within tide-marks, they generally adhere to the under-side of stones. The *Salpæ* occur only at the surface of the sea in summer, and when the weather is tranquil.

Identification.—The condition of existence, whether solitary, social (budding in groups from one root), or compound (many individuals being organically united into one or more systems); the connexion of the *mantle* with the *test*, whether they are united throughout, or only at the orifices; the texture of the *test;* the freedom or fixity of the individual; if fixed, the point and extent of its attachment; the relative situation of the orifices; the number of their rays when expanded; the presence and number of eyes; are important points to be noticed in the discrimination of species in this Class. The relative value of the characters may be in some measure inferred from the order in which they are here mentioned.

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organ." "The whole process differs from that common to animals in general in nothing but the independence and apparent individuality of the generative organ." (Phil. Trans. 1851, Part II. p. 578.)

Authorities.—I have been chiefly indebted to M. Savigny's "Mémoires sur les Animaux sans Vertèbres;" Dr. Milne-Edwards's "Observations sur les Ascidies Composées;" Messrs. Forbes and Hanley's "British Mollusca;" Siebold and Kölliker's "Anatomy of the Invertebrata" (Burnett's edition); and Professor Huxley's "Memoir on Salpa and Pyrosoma."

TUNICATA.

Molluscous animals enveloped in a *test* composed of *cellulose*, furnished with two orifices, a receiving (*branchial*) and a discharging (*anal*) one; mantle forming an interior tunic, also furnished with two orifices corresponding with those of the *test*, and adhering to them; gills occupying the interior surface of a membranous sac, hanging between the branchial orifice and the entrance of the stomach, and leading to the latter.

Animal attached; mantle united to the test only at the orifices.

Individuals organically united in systems	*Botryllidæ.*
Individuals distinct, but associated by a common root-thread	*Clavelinadæ.*
Individuals isolated	*Ascidiadæ.*

Animal free; test and mantle united throughout.

Orifices near together	*Pelonæadæ.*
Orifices placed at opposite extremities	*Salpadæ.*

FAMILY I. BOTRYLLIDÆ.

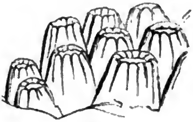
Aplidium (Sav.). Mass sessile, varying in form, gelatinous, or cartilaginous, composed of numerous systems, with no central cavity. Animals composed of thorax, fore-abdomen, and hind-abdomen; branching orifice six-rayed; anal orifice simple, indistinct.

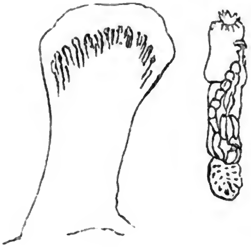
A. ficus. A. nutans.
fallax. Fig. 43; *n. s.* and *mag* verrucosum.

Sidnyum (Sav.). Mass a number of cones truncated and starred at the summit, rising from a common encrusting base, each including one system with a depressed centre. Animals composed of thorax and abdomen; branchial orifice eight-rayed.

S. turbinatum. Fig. 44; *n. s.*

44





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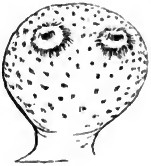

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Polyclinum (Sav.). Mass sessile, varying in form, gelatinous or cartilaginous, composed of numerous systems, which are convex and radiating, with a central cavity. Animals composed of thorax, fore-abdomen, and a long-stalked hind-abdomen; branchial orifice six-rayed; anal orifice projecting horizontally.

P. aurantium. Fig. 45; *n. s.*

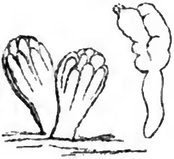
Amœrœcium (M.-Edw.). Mass lobed or encrusting, sessile or stalked; systems numerous, having a central cavity. Animals as in *Aplidium;* anal orifices opening into a common discharging vent.

A. proliferum. Fig. 46; *n. s.* and *mag.*
Nordmanni.
Argus.
albicans.

Leptoclinum (M.-Edw.). Mass thin, sessile, encrusting, varying in form; systems numerous. Animals composed of thorax and abdomen; branchial orifice six-rayed; anal orifice opening into a common vent, more or less ramified.

L. maculosum.
asperum.
aureum.

L. gelatinosum. Fig. 47; *n. s.*
Listerianum.
punctatum.



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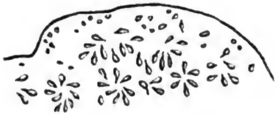
Distoma (Gaertn.). Mass sessile, cartilaginous, varying in form; systems numerous, circular. Animals placed irregularly in one or two ranks, composed of thorax and a stalked abdomen; branchial and anal orifices six-rayed.

D. rubrum. Fig. 48; *n. s.*
variolosum.

Botryllus (Gaertn.). Mass sessile, encrusting, gelatinous, composed of numerous systems, in which the animals are ranged horizontally in star-like circles around a common vent. Animals with no division of the body into parts; branchial orifice simple, remote from the vent.

B. Schlosseri.
polycyclus. Fig. 49; *n. s.*
gemmeus.

B. violaceus.
smaragdus.
bivittatus.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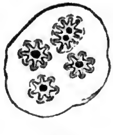
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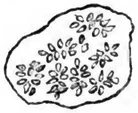
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Botrylloïdes (M.-Edw.). Resembling *Botryllus,* but the systems forming irregularly-branched or winding lines. Animals placed vertically; the two orifices near together.

B. Leachii.
albicans.

B. rotifera.
rubra. Fig. 50; *n. s.*

Syntethys (Forbes). Mass sessile, gelatinous, forming a single system. Animals sessile, having simple orifices without rays.

S. Hebridicus. Fig. 51; ½ *n. s.*

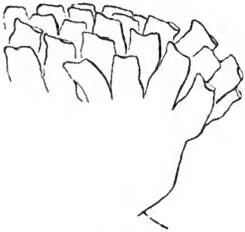
FAMILY II. CLAVELINADÆ.

Clavelina (Sav.). Animals oblong, erect; thorax marked with coloured lines.

C. lepadiformis. Fig. 52; *n. s.*
producta.
pumilio?

Perophora (Wiegm.). Animals roundish, compressed; thorax not marked with lines.

P. Listeri. Fig. 53; *n. s.* and *mag.*



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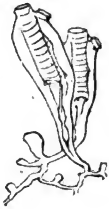

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Family III. Ascidiadæ.

Ascidia (Bast.). Body sessile; test more or less leathery; branchial sac not folded, surmounted by a circle of simple tentacles; branchial orifice eight-lobed; anal six-lobed; both circular.

A. intestinalis.
canina.
venosa.
mentula.
arachnoïdea.
scabra.
virginea. Fig. 54; *n. s.*
A. parallelogramma.
prunum.
aspersa.
vitrea.
conchilega.
orbicularis.
echinata.

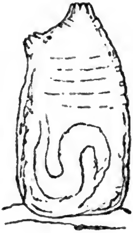
Molgula (Forbes). Body globose, attached or free; test membranous, usually invested with foreign matters; branchial orifice six-lobed; anal four-lobed; both on very contractile, naked tubes.

M. oculata.
tubulosa. Fig. 55; *n. s.*

Cynthia (Sav.). Body sessile; test leathery; branchial sac folded lengthwise: both orifices four-sided.

C. microcosmus.
claudicans.
tuberosa.
quadrangularis. Fig. 56; *n. s.*
informis.
tesselata.
limacina.

C. morus.
rustica.
grossularia.
ampulla.
mammillaris.
aggregata.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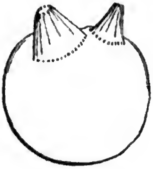
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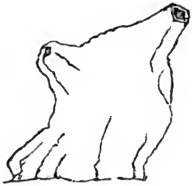
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FAMILY IV. PELONÆADÆ.

Pelonæa (Forbes). Test cylindrical, unattached; orifices without rays, on two equal approximate warty eminences at the fore extremity.

P. corrugata. Fig. 57.
glabra.

FAMILY V. SALPADÆ.

Salpa (Gmel.). Test and mantle cylindrical or oval, open at both extremities; anal orifice wide, transverse, and furnished with a valve; swims freely in the ocean.

S. runcinata. Fig. 58; *n. s.*

Appendicularia (Chamisso). Test and mantle flask-shaped, gelatinous, transparent, with a branchial orifice at the smaller end; vent opening on the back; a broad, ribbon-like, erect tail.

A. flagellum ? Fig. 59; ¼.

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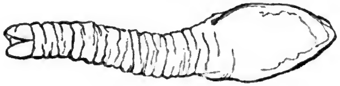

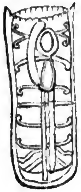

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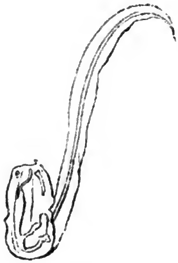

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CLASS III. CONCHIFERA.

(BIVALVES.)

A BIVALVE may be considered as a Tunicate more or less opened down one side (the ventral side), and enveloped in a *shell* instead of a *test*. Hence the shell (representing the test), the mantle, and the breathing organ, instead of being so many sacs, are all composed of leaves facing each other, opening in front, and united at the back, exactly like the covers and leaves of a book.

The shell is the outermost envelope. It consists of a pair of valves, more or less exactly corresponding to each other in size and shape. Its substance is carbonate of lime deposited in membranous cells, or in membranous folds. By means of acids the lime may be wholly dissolved away, and the membranous base remains, retaining the form without the consistence of the original shell.

Considered as to its structure, shell consists of two very distinct portions. The outer layer is formed of close prisms of lime, or rather cells filled with lime, standing perpendicularly or obliquely to the plane of the valve. They are deposited at certain definite periods by the mantle-borders, in a manner to be described presently. The inner layer is more or less pearly, and is composed of thin coats of lime, not contained in cells, but deposited in folds of the membranous base. The origin of this layer is the whole outer surface of the mantle-leaves.

The shell-valves are not united to the contained animal, except at certain points by the insertion of the ends of certain muscles, and by a horny skin (*epidermis*) belonging to the mantle, and stretching over the edges of the valves and upon their exterior. Sometimes the *epidermis* encloses even the siphons, but in many cases it is not to be detected at all.

At the back the valves are connected together partly by an elastic dense substance, somewhat resembling india-rubber (the *ligament*), and partly by a hinge, usually made of teeth and cavities fitting into each other. The use of the *ligament* is to force open the valves, in opposition to the contractile power of the muscles within, which draw them together. The *ligament* may be placed within or without the hinge, or partly the one and partly the other. In the former case the fibres are compressed, and in the latter they are stretched when the valves are closed; in either case it is their elasticity which opens the valves.

On separating the valves, we see next the two leaves of the *mantle*. These are delicately thin, except at their external edges, where they are somewhat thickened. These margins, also, are frequently furnished with sensitive tentacles and other organs of sense, as well as with glands, which are often highly coloured. One prominent function of the mantle is the formation and periodical increase of the shell, the process of which has been so graphically described by Professor Jones that I shall cite his words:—

"When the animal is engaged in increasing the dimensions of its abode, the margin of the mantle is protruded, and firmly adherent all round to the circumference of the valve with which it corresponds. Thus circumstanced, it secretes calcareous matter, and deposits it in a soft state upon the extreme edge of the shell, where the secretion hardens and becomes converted into a layer of solid testaceous substance. At intervals this process is repeated, and every newly-formed layer enlarges the diameter of the valve. The concentric strata thus deposited remain distinguishable externally, and thus the lines of growth marking the progressive increase of size may easily be traced.

"It appears that at certain times the deposition of calcareous substance from the fringed circumference of the mantle is much more abundant than at others: in this case ridges are formed at distinct intervals; or, if the border of the mantle at such periods shoots out beyond its usual position, broad plates of shell, or spines of different lengths, are secreted, which, remaining permanent, indicate, by the interspaces separating successively deposited growths of this description, the periodical stimulus to increased action that caused their formation.

"Whatever thickness the shell may subsequently attain, the external surface is thus exclusively composed of layers deposited in succession by the margin of the mantle; and, seeing that this is the case, nothing is more easy than to understand how the colours seen upon the exterior of the shell are deposited, and assume that definite arrangement characteristic of the species. We have already said that the border of the mantle contains, in its substance, coloured spots: these, when minutely examined, are found to be of a glandular character, and to owe their peculiar colours to a pigment secreted by themselves; the pigment so furnished being therefore mixed up with the calcareous matter at the time of its deposition, coloured lines are found upon the exterior of the shell wherever these glandular organs exist. If the deposition of colour from the glands be kept up without remission during the enlargement of the shell, the lines upon its surface are continuous and unbroken; but if the pigment be furnished only at intervals, spots or coloured patches of regular form, and gradually increasing in size with the growth of the mantle, recur in a longitudinal series wherever the paint-secreting glands are met with. . . .

"While the margin of the mantle is thus the sole agent in enlarging the *circumference* of the shell, its growth in *thickness* is accomplished by a secretion of a kind of calcareous varnish, derived from the external surface of the mantle generally; which, being deposited layer by layer over the whole interior of the previously existing shell, progressively adds to its weight and solidity. There is, moreover, a remarkable difference between the character of the material secreted by the marginal fringe, and that furnished by the general surface of the [mantle-membrane]: the former we have found to be more or less covered by glands appointed for the purpose, situated in the circumference of the mantle; but as these glands do not exist elsewhere, no colouring matter is ever mixed with the layers that increase the thickness of the shell, so that the latter always remain of a delicate white hue, and form the well-known iridescent material usually distinguished by the name of *nacre*, or *mother of pearl.*" *

When we have removed the mantle-leaves, we find beneath them the *gill-leaves*, two on each side. These, like the mantle-leaves and the shell-valves, are open in front, and united at the back. Each leaf consists of a series of close-set transverse tubes, which open into channels leading into a cavity behind the united leaves. These tubes are clothed with *cilia*, which maintain a constant current in the water that bathes them.

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* Gen. Outline, 385.

In most of the members of this Class there are two openings, exactly as in the TUNICATA: the one for the admission of water, the other for its rejection. These often take the form of tubes (*siphons*), more or less lengthened and projected at will from the shell. The receiving siphon communicates with the cavity included between the gill-leaves, the discharging one with another cavity behind the leaves. In some species, however, the discharging siphon alone is present, the receiving one merging into the wider opening of the mantle-leaves; while in the Oyster family there are no siphons, the mantle being entirely open.

Within the innermost pair of gill-leaves are placed the various viscera, and in particular those of the digestive system. As in the TUNICATA, the entrance to the stomach is placed at the bottom of the breathing organ, receiving the minute atoms of food that has been collected from the water-currents. The mouth, thus placed, is guarded by tumid *lips*, and by one or two pairs of broad membranous *palps*, or organs of a delicate sense. The food of all bivalves is microscopically minute; it consists very largely of those dubious objects, abounding in both fresh and sea water, which occupy a debatable position between the animal and vegetable kingdoms,—the *Diatomaceæ*, &c.*

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* The membranous palps, in many species, form so many grooves leading to the mouth, and the particles of food travel along them by means of the *cilia* with which they are bordered.

The notion that Oysters can be fattened on oatmeal is a vulgar error.

The stomach and intestine are very simple, and the latter opens into the chamber of the discharging siphon.

The nervous system now becomes well developed. It consists of three pairs of principal ganglions with their branches.

Organs of sense are likewise possessed by this Class in an advanced condition of development. Besides the palps just noticed, many of the species which have the mantle open carry sensitive lengthened *tentacles* along its borders, set sometimes in a single, sometimes in double rows. In the Scallops (*Pecten*), these are seen to great advantage. The openings of the siphons are also generally protected by tentacles, which close down and form a sort of network across the orifice. In *Pholas dactylus*, these are curiously branched, like the tentacles which surround the mouth of the *Holothuriæ*.*

The *organs of hearing* consist of a pair of transparent capsules filled with a clear fluid. Each contains a glassy globule, which constantly maintains a very singular swinging and rotatory motion, that instantly ceases when the capsule is ruptured. These capsules are situated in the *foot*.

Organs of vision are much more obvious, at least in many species, being often highly coloured,

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"The important part which this apparatus serves in the taking of food, may be seen by covering the palps of *Anodonta*, &c., with any coloured powder. This powder is carried by the *cilia* from the surface to the borders of the palps, thence upon their transversely grooved internal surfaces into the angle formed by these latter, thence into currents of the grooves, and so direct into the mouth."—SIEBOLD's *Anat. of the Invertebrata*, § 189.

* See my "Devonshire Coast," p. 66, and pl. ii.

very numerous, and prominently situated. They may be well studied in the common Scallop (*Pecten opercularis*), where they occur in great numbers, placed among the tentacles on the borders of the mantle. They are beautiful objects, as they gleam with the radiance of precious stones. In other genera the eyes are differently placed; as near one or the other extremity of the mantle (the fore part in *Pinna*, the hind in *Tellina*), or around the siphon-orifices, as in *Pholas*, *Venus*, and *Solen*. In the Cockle (*Cardium*) the short siphons are surrounded with an extraordinary number of tentacles, capable of elongation and protrusion, each of which bears an eye of diamond-like brilliancy.*

There is in many CONCHIFERA a curious organ, known, from some of its functions, as the *foot*. It is a muscular mass, frequently of great size, and capable of being pushed out from between the mantle and valves to a long distance. It sometimes acts as a pushing pole, and at others as an anchor. In the boring kinds, which live in sand or mud, it is the organ by which they form their perforations, and descend into them. Being stretched to its utmost, the extremity, which is generally pointed, is inserted into the soil; then being bent up in the form of a hook, the whole organ is suddenly and forcibly contracted; the hook maintains its hold of the mud, and the result is that the whole animal with its shell is dragged into the hole. The Cockles are able to perform vigorous leaps by means of this well-developed and versatile foot.

In other species the foot is grooved; and being associated with a gland which has the power of secreting a glutinous substance, the latter is drawn out by means of the groove into slender threads, which are attached by their tips to the rocks and other foreign bodies. The grooved foot is then withdrawn, and the thread presently hardens into a very strong, highly elastic sort of silk, called *byssus*. It is by the aggregation of many such threads that the common Mussel (*Mytilus*) moors itself to the rocks and to its fellows.

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* Siebold, Anat. Invert. § 187.

It is not only soft mud or sand that yields to the burrowing efforts of the CONCHIFERA. Not a few among them bore tunnels into clay, wood, chalk, shale, sandstone, and even the most compact marble. The mode in which this is performed is not yet ascertained. It cannot be by a chemical solvent secreted by the animal, since there is no menstruum known which will act on substances so varied. The constant rotation of the rough shell-valves, the application of the end of the foot, which in some cases is said to be studded with flinty points, and the incessant projection of ciliary currents, wearing away the substance atom by atom, have all been suggested, and are each maintained, as the effective *modus operandi*, by names of reputation. Perhaps all of these may be in turn employed; for no one of them seems to afford a satisfactory solution of *all* the difficulties.

With one or two doubtful exceptions, the CONCHIFERA have the sexes distinct, though, for the most part, the distinction can be recognised only by anatomical examination. The eggs are received into one or other of the pairs of gill-leaves, which become much swollen with their presence.

The young are hatched before they leave the parent, but present a form and structure totally unlike those of the adult. They, therefore, pass through a metamorphosis. The embryo form appears to differ in different genera. In some, as the *Unionidæ*, or Freshwater Mussels, there is a pair of three-sided valves, partly enveloping a round mass covered with cilia, which, while in the egg, continually rotated. The rotatory movement soon ceases, and the embryo divides into halves, each covered by a valve. Each portion of this double animal has a ciliated mouth near the hinge, and a proper intestine of its own. In the middle of the angle formed by these halves is raised a short hollow cylinder,—the *byssus*-forming organ, out of which projects a very long transparent *byssus*.

"Near the hinge a large muscle passes from one valve to the other; this, from the convulsive contractions which occur from time to time, gradually approximates the valves, which are wide open when the young individual escapes from the egg. These valves are trigonal and slightly convex. One of their sides goes to form the hinge, while the two remaining, which are a little arched, unite at an angle opposite. With this angle is articulated a prolongation curved downwards and inwards, and whose convex side has several spines. After their escape from the eggs, these embryos are held together by their entangled *byssuses*. Subsequently, when the adductor-muscle has definitely closed the valves, the embryonic halves are blended together, probably by a new metamorphosis." *

The young of *Modiola* and *Kellia* are formed on an entirely different type. Their two valves, which are only slightly separated, are overlapped by two lobes, which are everted and provided with very active vibratile cilia: the young swim by means of these lobes.* The embryos of *Teredo* have been also observed swimming freely about by means of a foot-like organ, which protrudes between the valves, and presents an active ciliary movement.†

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* Siebold, Anat. Invert. § 200.

In order to apprehend aright the technical descriptions of families and genera in this Class, it may be needful to explain the principal terms used. The valves are hollow cones, the points of which are bent over towards one side. In some cases the conical form can scarcely be recognised, except by comparison with others, such as *Isocardia*, in which the points are much developed and curled in a spiral manner. The point is termed the *beak* (*umbo*) of the valve.

The side towards which the beaks twist is the front side, and on this side, beneath the beaks, is often a depressed space termed the *lunule*, while on the hinder side is placed the *ligament*. The *lunule*, *umbo*, and *ligament*, constitute the *dorsal* or back border; the opposite side to this, or that which gapes, is of course the ventral border. The *length* of a shell measures a line drawn from the dorsal to the ventral border; the *width*, therefore, is a line at right angles to this; and the thickness is measured from the centre of one valve to that of the other, through the body of the animal.

The *siphons*, when present, project from the hinder side; the more ventral one is the receiving or *branchial* siphon, the more dorsal the discharging or *anal*. The foot usually points towards the front. When once we know the back and the belly, the front and the hind ends, it is of course easy to know the right and the left valve. Make the two valves to stand on their open edges, with the beaks uppermost, the ligament and the siphons next your body; then the right and left valves will answer to your right and left hands.

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* Lovén, Arch. Skand. i. 155.

† Siebold, Op. cit. § 200.

The interior of the valves is marked by one or two *muscular impressions*,—depressed spaces, where the great muscles for drawing the valves together were inserted. Connecting these there is a mark, more or less bent in a sinuous manner, where the mantle was attached to the valve. This line is called the *pallial* impression, or the scar of the mantle (*pallium*).

When one valve is the counterpart of its fellow, the shell is said to be *equal-valved;* when the fore half and the hind half of the same valve are nearly equal, it is said to be *equal-sided.* In general the CONCHIFERA are unequal-sided, the front half being the shorter.

The hinge is formed of variously shaped teeth and depressions. Those teeth that are placed directly under the beak are called *cardinal* teeth; those on either side are *lateral* teeth.

Localities, &c.—The Oysters, the Scallops, and some other kinds dwell in deep water, associated in what are called beds. The *Anomiæ* are always attached by one valve to stones, or, in the case of the smaller species, to sea-weeds. The Scallops and the *Limæ* can swim with a spasmodic flitting motion, by forcing jets of water through the compressed edges of the mantle.* The great Wing-shells (*Pinna*) stand upright on the sea-bottom, the pointed end sunk deeply into the mud. The Mussel associates in dense beds on rocks between tide-marks. The little *Crenellæ* crawl about bushy sea-weeds, by means of their long foot. The *Modioli* and the *Arcæ* hide in crevices of rocks, and under stones. The Cockles, the *Veneridæ*, the *Mactradæ*, the *Donacidæ*, the *Tellinadæ*, the Razors (*Solenidæ*), and the Gapers (*Myadæ*), all burrow into mud or sand, from the level of the tide to great depths. The *Gastrochænadæ* and the *Pholadidæ* bore into stone and other substances, and the dreaded Ship-worm (*Teredo*) into submerged timber.

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* See my "Devonshire Coast," p. 51.

Identification.—Mr. S. P. Woodward enumerates, as "characters which have been most relied on for distinguishing" the families and genera of Conchifera, the following, stated nearly in the order of their value :—

"The extent to which the mantle-lobes are united; the number and position of muscular impressions; the presence or absence of a *pallial sinus;* the form of the foot; the structure of the gills; the microscopic structure of the shell; the position of the ligament, internal or external; the dentition [toothing] of the hinge; equality or inequality of the valves; regularity or irregularity of form; the habit, whether free, burrowing, or fixed; the medium of respiration, whether fresh or salt water."*

Authorities.—For structure, I have been much indebted to Siebold's "Comparative Anatomy of the Invertebrata;" for systematic arrangement, I have consulted Forbes and Hanley's elaborate

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* Manual of the Mollusca, 253.

"British Mollusca;" but have mainly followed Mr. S. P. Woodward's valuable "Manual of the Mollusca."

CONCHIFERA.

Molluscous animals enveloped in a *shell* composed of carbonate of lime, forming two valves, connected by a joint, and applied the one to the right, the other to the left side; mantle two-leaved, more or less open ventrally, generally with two orifices behind; gills four-leaved; no head; mouth placed at the angle of the gills, furnished with lips and palps; sexes distinct; young undergoing a metamorphosis.

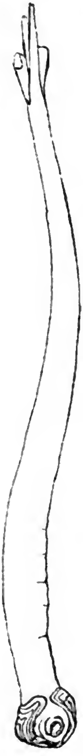
Pallial line sinuous	*Sinupallialia.*
Pallial line simple.	*Integropallialia.*

Order I. SINUPALLIALIA.

Mantle closed:	
Foot short, truncate; shell gaping at both ends	*Pholadidæ.*
Foot small, finger-shaped; shell gaping in front	*Gastrochænadæ.*
Foot small, tongue-shaped; shell closed, or gaping behind.	
Shell thin, pearly within . . .	*Anatinadæ.*
Shell thick, opaque, dull . . .	*Myadæ.*
Mantle open in front:	
Foot cylindrical; shell very broad, gaping at both ends	*Solenidæ.*
Foot compressed, tongue-shaped; shell closed, or nearly so.	
Siphons separate	*Tellinadæ.*
Siphons united.	
Ligament internal	*Mactradæ.*
Ligament external . . .	*Veneridæ.*

FAMILY I. PHOLADIDÆ.

Shell gaping at both ends, thin, white, roughened like a rasp, without hinge or ligament; strengthened by accessory valves. Animal club-shaped; foot short, truncate; mantle open only for the protrusion of the foot; siphons large and long, united nearly to their tips, their orifices fringed. Borers into various substances.



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Teredo (Adanson). *Ship-worm.* Shell of two curved equal valves, gaping at both ends. Animal worm-like, not covered by the shell; mantle tubular; siphons long, forked at the tips. Bores into wood, which it lines with a shelly tube.

T. Norvegica. Fig. 60; *n. s.*
navalis.
megotara.
bipennata.

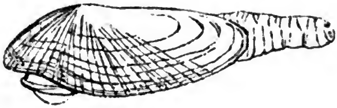
Xylophaga (Turton). Shell as in *Teredo*, but gaping only in front. Animal covered by the shell; makes a cavity in wood, which is not lined with shell.

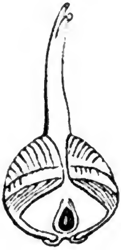
X. dorsalis. Fig. 61; *n. s.*

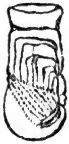
Pholas (Linn.). *Piddock.* Shell oval or oblong, equal-valved, unequal-sided, gaping, chiefly in front; exterior beset with transverse ridges, and longitudinal furrows; beaks covered with callosities; accessory pieces to the valves. Animal thick; siphons very long, united except at the tips, which are fringed, but not disked; foot large, short, truncate. Bores into various substances.

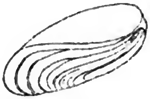
P. dactylus.
  parva. Fig. 63; *n. s.*
  crispata.
  candida.

63









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Pholadidea (Leach). Nearly as *Pholas*, but the shell has no callosities, and there is a cup-like appendage surrounding the base of the siphons; the siphons terminate in a fringed disk.

P. papyracea. Fig. 62; *n. s.*

FAMILY II. GASTROCHÆNADÆ.

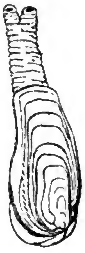
Shell equal-valved, very unequal-sided, gaping in front; pallial line sinuated. Animal oblong or club-shaped; siphons capable of being greatly lengthened, wholly united; mantle closed, except to give exit in front to a minute foot. Bores into stone.

Gastrochæna (Spengler). Shell wedge-shaped, widely gaping; hinge toothless. Animal—siphons separate only at the tips; orifices simply fringed; the whole enclosed in a flask-like calcareous tube.

G. modiolina. Fig. 64; *n. s.*

Saxicava (De Bellevue). Shell oblong; hinge with cardinal teeth. No tube.

S. arctica.
  rugosa. Fig. 65; *n. s.*



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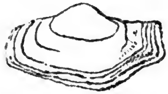

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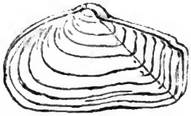
FAMILY III. ANATINADÆ.

Shell usually unequal-sided, thin, granular on the outside, pearly within; ligament external, thin; cartilage internal, placed in corresponding pits, and often furnished with a free shelly piece (*ossicle*); muscular impressions faint, the front one lengthened; pallial line usually sinuated. Animal with a closed mantle; siphons usually long, more or less united, fringed; gills single on each side; foot small, tongue-shaped.

Pandora (Lamk.). Shell pearly, the left valve convex, the other flat; hinge teeth $\frac{1}{1}$ with pits.

Animal compressed; foot tongue-shaped; siphons short, separate, and diverging at the tips.

P. rostrata.
obtusa. Fig. 66; *n. s.*



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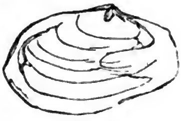

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Lyonsia (Turton). Shell convex on both sides; hinge toothless, but furnished with a moveable shelly piece, connected with each valve.

L. Norvegica. Fig. 67; ½ *n. s.*

Thracia (Leach). Shell transversely ovate, thin, unequal-valved, nearly equal-sided; hinge a thickened shelly fulcrum in each valve; ligament partly internal; beaks entire. Animal—siphons long, entirely separated.

T. phaseolina.
villosiuscula.
pubescens. Fig. 68; ⅓ *n. s.*

T. convexa.
distorta.

Cochlodesma (Couthouy). As *Thracia*, but the hinge a spoon-shaped horizontal process in each valve; ligament external, slight; beaks fissured.

C. prætenue. Fig. 69; *n. s.*

FAMILY IV. MYADÆ.

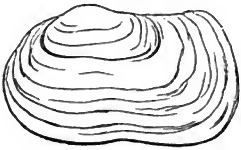
Shell thick, strong, opaque, gaping behind, covered with a wrinkled skin (*epidermis*). Animal with the mantle closed, giving issue to a small foot; siphons united, wholly or partly retractile;

gills two on each side. Burrowers in mud, sand, and rarely in stone.

Panopæa (Menard). Shell equal-valved, oblong, gaping at both ends; hinge-teeth $\frac{1}{1}$ prominent; ligament external on ridges. Animal with long united siphons, and a short, thick foot.

P. Norvegica. Fig. 70 ; $\frac{1}{2}$ *n. s.*

70



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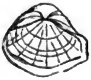


73

Poromya (Forbes). Shell ovate or roundish, equal-valved, unequal-sided; surface punctated, covered with a rough epidermis; hinge a minute erect cardinal tooth in one valve, and a pit in the other. Animal with short siphons, surrounded by tentacles at their base; foot long, slender.

P. granulata. Fig. 71 ; *n. s.*

Neæra (Gray). Shell pear-shaped, globose, unequal-valved, smooth; hinge an oblique spoon-like piece in each valve, with sometimes a minute tooth beside it, and a lateral tooth. Animal with short siphons, and a lanceolate foot.

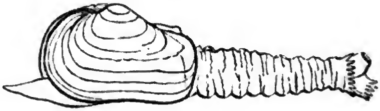
N. cuspidata. Fig. 72 ; *n.s.*
costellata.
abbreviata.

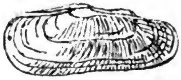
Corbula (Bruguiere). Shell roundish, nearly equal-sided, very unequal-valved; hinge a tooth in one or both valves, with socket and ligamental pit beside it. Animal with very short united siphons; fringed orifices; mantle opening for the passage of a narrow thick foot; anal siphon with a projecting tubular membrane.

C. nucleus. Fig. 73; *n. s.*
rosea.

74

75





76

77

Sphænia (Turton). Nearly as *Corbula*. Shell oblong; hinge an erect dilated tooth in one valve, and a socket in the other.

S. Binghami. Fig. 74; *n. s.*

Mya (Linn.). *Gaper*. Shell rhomboidal, equal-valved; hinge a spoon-shaped process in the left valve, and a socket in the right. Animal with l retractile siphons, and a small conical foot.

M. truncata. Fig. 75; ½ *n. s.*
arenaria.

FAMILY V. SOLENIDÆ.

Shell ntly dilated, parallel-sided, gaping at covered w ligament external; hinge with com-
with the r
foot; siphor

pressed teeth, the hind one cleft. Animal with a large, powerful, cylindrical foot; gills narrow, prolonged into the receiving siphon. Burrowers in sand.

Solecurtus (De Blainv.). Shell swollen, with the beaks nearly central; hinge-teeth $\frac{2}{2}$; ligament prominent. Animal large, not wholly contained in the shell; siphons united, and bulging at the bases; the receiving orifice fringed.

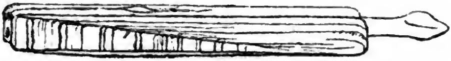
S. coarctatus.
  candidus. Fig. 76; $\frac{1}{2}$ *n. s.*

Ceratisolen (Forbes). Shell compressed; hinge complex; teeth $\frac{3}{2}$. Animal compressed; siphons separate, diverging, fringed.

C. legumen. Fig. 77; $\frac{1}{3}$ *n. s.*

Solen (Linn.). *Razor-shell.* Shell excessively broad, sub-cylindrical, straight, or slightly curved, unequal-sided; surface divided diagonally; hinge-teeth $\frac{2}{2}$; ligament long, external. Animal with the mantle open in front, for the passage of a long, thick, truncate foot; siphons short, united, fringed.

S. marginatus.
  siliqua. Fig. 78; $\frac{1}{3}$ *n. s.*
  ensis.
  pellucidus.



78

FAMILY VI. TELLINADÆ.

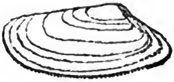
Shell free, flattened, usually closed, and equal-valved; muscular impressions rounded, polished;

pallial sinus very large; ligament on shorter side of shell, sometimes internal. Animal with the mantle widely open in front, its margins fringed; foot compressed, tongue-shaped; siphons separate, generally very long and slender; palps large, triangular. Burrowers in sand.

Donax (Linn.). *Wedge-shell.* Shell three-sided, wedge-shaped, closed; the front produced, rounded; hinder side short, straight; the edges notched; teeth $\frac{1}{1}$, $\frac{2}{2}$, $\frac{1}{1}$. Animal with short siphons; foot very large, pointed; palps small.

D. anatinus. Fig. 79; $\frac{1}{2}$ *n. s.*
politus.
trunculus.

79



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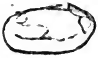
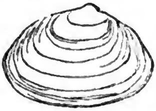




81

82

Ervilia (Turton). Shell minute, oval; right valve with one prominent tooth in front, and an obscure one behind; left with two obscure teeth; no laterals.

E. castanea. Fig. 80; *n. s.*

Scrobicularia (Schumacher). Shell oval, nearly equal-sided; hinge-teeth small, $\frac{1}{1}$ or $\frac{2}{2}$; no laterals.

Animal with very long siphons; palps large, triangular.

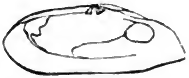
S. piperata. Fig. 81; $\frac{1}{2}$ *n. s.*

Syndosmya (Recluz). Shell small, oval, white, shining; hinder side the shorter; beaks directed backward; hinge-teeth wanting or minute, laterals distinct; pallial sinus wide, shallow.

S. alba. Fig. 82; *n. s.*, and hinge *mag.*
intermedia.
prismatica.
tenuis.

Psammobia (Lamk.). Shell oblong, smooth, or striated radiately; covered with a thin epidermis; hinge-teeth $\frac{2}{1}$; pallial sinus deep, reducing the front to a line.

P. vespertina.
Ferroensis. Fig. 83; $\frac{1}{2}$ *n. s.*
tellinella.
costulata.



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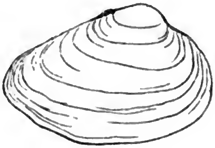


84

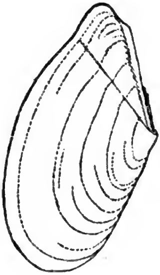
Diodonta (Deshayes). Shell convex, with scale-like lines of growth; no epidermis; hinge-teeth $\frac{2}{1}$, the single tooth cleft. Animal with a small foot; siphons long, fringed.

D. fragilis. Fig. 84; *n. s.*

Tellina (Linn.). Shell rounded in front, angular, and slightly folded behind; teeth $\frac{1}{1}$, $\frac{2}{2}$, $\frac{1}{1}$; the laterals indistinct in the left valve; pallial sinus very wide and deep. Animal with broad, pointed foot; siphons slender, rather long, not fringed.

T. crassa.
balaustina.
donacina.
pygmæa.
incarnata. Fig. 85; *n. s.*

T. tenuis.
fabula.
solidula.
proxima.
bimaculata.



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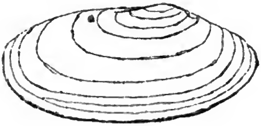


86

Family VII. Mactradæ.

Shell more or less three-sided, equal-valved, closed, or slightly gaping; surface nearly smooth, covered with a thick epidermis; ligament internal, set in a triangular pit; hinge with two divergent teeth, and usually with laterals on each side; pallial sinus short, rounded. Animal with united siphons, and a compressed foot.

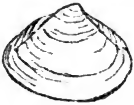
Lutraria (Lamk.). Shell oblong, gaping at each end; cartilage-plate prominent, with one or two small teeth in front in each valve. Animal with mantle closed, except a moderate foot-orifice.

L. elliptica. Fig. 86; $\frac{1}{4}$ *n. s.*
oblonga.

Mactra (Linn.). Shell nearly equal-sided, triangular; hinge composed of a V-shaped cardinal tooth in one valve, locking into a margined pit in the other, and of a long lateral tooth on each side, which fits into a deep groove with tooth-like edges. Animal with the mantle open to the siphons, fringed at the edges; foot heeled.

M. elliptica.
helvacea.
solida.

M. stultorum. Fig. 87; ½ *n. s.*
subtruncata.
truncata.



87

88

FAMILY VIII. VENERIDÆ.

Shell regular, closed, round or oblong; ligament external; hinge usually three diverging teeth in each valve; muscular impressions oval, polished; pallial line sinuated. Animal free, creeping by means of a tongue-shaped, flattened foot; mantle generally with a large opening in front; siphons unequal, more or less united.

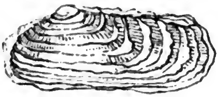
Petricola (Lamk.). Shell oblong, thin, swollen; front side short. Animal with the mantle closed in front; foot small, pointed. Bores into limestone.

P. lithophaga. Fig. 88; *n. s.*

Venerupis (Lamk.). Shell oblong, slightly gaping behind, marked with radiating lines, and concentric elevated plates; hinge-teeth small, one of them cleft; pallial sinus angular. Bores into rocks.

V. irus. Fig. 89; *n. s.*

89



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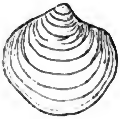

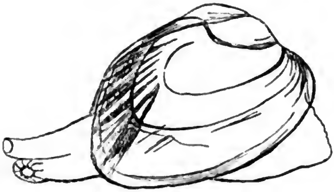

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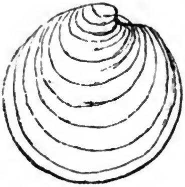


92

Tapes (Mühlfeldt). Shell oblong; beaks in front; margins smooth; hinge-teeth more or less cleft; pallial sinus rounded.

T. aurea.
decussata.
pullastra. Fig. 90; *n. s.*
T. perforans.
virginea.

Lucinopsis (Forbes). Shell compressed; teeth in right valve two, laminar, diverging; in left three, the middle one cleft; pallial sinus very deep, ascending. Animal with a small foot-opening; foot pointed; mantle-edges plain; siphons rather long, separate, diverging, with fringed orifices.

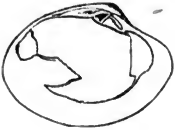
L. undata. Fig. 91; ½ *n. s.*

Artemis (Poli). Shell round, compressed, marked with concentric lines; ligament sunk, margins smooth; hinge with three cardinal teeth, and one front tooth beneath the lunule. Animal with a large, hatchet-shaped foot; edges of the mantle slightly plaited; siphons entirely united, plain.

A. exoleta. Fig. 92; $\frac{1}{2}$ *n. s.*
lincta.

Cytherea (Lamk.). Shell thick, ovate or round; margins single; hinge as in *Artemis*. Animal with the mantle-edges plain; siphons united half-way.

C. Chione. Fig. 93; $\frac{1}{3}$ *n. s.*



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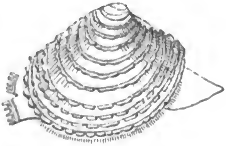


94

Venus (Linn.) Shell thick, ovate or round, often marked with crossed furrows; margins minutely notched; hinge-teeth $\frac{3}{3}$; ligament prominent; lunule distinct; pallial sinus small, angular. Animal with mantle-edges fringed; siphons separate.

V. casina.
fasciata.
gallina.

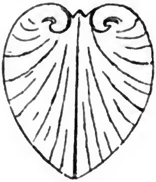
V. ovata.
striatula.
verrucosa. Fig. 94; *n. s.*

Order II. INTEGROPALLIALIA.

Furnished with siphons	*Siphonida.*
Without siphons	*Asiphonida.*

TRIBE I. SIPHONIDA.

Shell without ribs.	
Ligament external, conspicuous; foot thick, tongue-shaped	*Cyprinadæ.*
Ligament internal or obsolete; foot long, cylindrical, or strap-shaped .	*Lucinadæ.*
Shell marked with radiating ribs	*Cardiadæ.*



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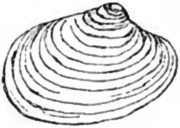


96

FAMILY I. CYPRINADÆ.

Shell regular, thick, solid, smooth, or marked with concentric lines, usually covered with a thick epidermis; ligament external, conspicuous; pallial line simple. Animal with the mantle-leaves united behind by a curtain, pierced with two siphonal orifices; foot thick, tongue-shaped.

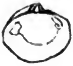
Isocardia (Lamk.). *Heart-shell.* Shell heart-shaped, inflated; beaks distant, spirally rolled; teeth $\frac{1}{1}$, $\frac{2}{2}$, $\frac{1}{1}$. Animal with siphons close together, short, fringed; foot pointed.

I. cor. Fig. 95; $\frac{1}{3}$ *n. s.*

Astarte (Sowerby). Shell roundish, flattened, thick; lunule distinct; hinge-teeth $\frac{2}{2}$; the front tooth in the right valve large and thick. Animal with the siphons not fringed.

A. arctica.
compressa.
crebricostata.
elliptica. Fig. 96; *n. s.*
A. Scotica.
sulcata.
triangularis.

97



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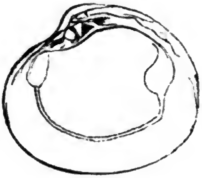


99

100

Circe (Schum.). Shell nearly as *Astarte*, but the hinge-teeth $\frac{3}{3}$. Animal with fringed siphonal orifices, scarcely projecting; foot large, heeled.

C. minima. Fig. 97; *n. s.*

Cyprina (Lamk.). Shell oval, large, strong; ligament prominent; no lunule; teeth $\frac{0}{1}$, $\frac{2}{2}$, $\frac{1}{0}$. Animal with fringed siphons, short, but projecting.

C. Islandica. Fig. 98; $\frac{1}{4}$ *n. s.*

FAMILY II. LUCINADÆ.

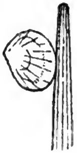
Shell roundish, closed; interior dull, obliquely furrowed; ligament inconspicuous or sub-internal; muscular impressions lengthened, rough; pallial line simple. Animal with the mantle-leaves open below; siphonal orifices one or two; foot lengthened, cylindrical or strap-shaped, protruded at the base of the shell.

Galeomma (Turton). Shell thin, oval, equal-sided, gaping widely below, covered with a thick fibrous epidermis; ligament internal; teeth $\frac{0}{1}$. Animal with one siphonal orifice.

G. Turtoni. Fig. 99; *n. s.*

Lepton (Turton). Shell roundish, flattened; hinge-teeth $\frac{0}{1}$ or $\frac{1}{1}$, in front of an angular cartilage notch; laterals $\frac{2}{2}$, $\frac{1}{1}$. Animal with one siphon; mantle edges fringed; foot thick, heeled and grooved, forming a creeping disk.

L. Clarkiæ.
convexum.
nitidum.
squamosum. Fig. 100; *n. s.*



101

102

103

Montacuta (Turton). Shell minute, oblong, hinge-line notched; ligament internal, between two diverging teeth. Animal with the mantle-edges simple, open in front.

M. bidentata.
ferruginosa.
substriata. Fig. 101; *mag.*

Kellia (Turton). Shell small, roundish; beaks small; margins smooth; ligament internal; teeth $\frac{1}{1}$, $\frac{1}{1}$, $\frac{1}{1}$, or $\frac{1}{1}$, $\frac{2}{2}$, $\frac{1}{1}$. Animal with one siphon.

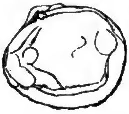
K. suborbicularis. Fig. 102; *n. s.*
rubra.

Turtonia (Hanley). Shell oblong, unequal-sided; ligament concealed between the valves; hinge-teeth $\frac{2}{2}$. Animal with one siphon, lengthened.

T. minuta. Fig. 103; *mag.*

Diplodonta (Bronn.). Shell roundish, smooth; ligament double, rather long, sub-marginal; hinge-teeth $\frac{2}{2}$, the front tooth in the left valve, and the hind one in the right, cleft; muscular impressions polished. Animal with the mantle-edges plain, united; siphons two, unfringed.

D. rotundata. Fig. 104; *n. s.*



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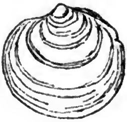


105

Lucina (Bruguière). Shell round, white; beaks depressed; lunule distinct; ligament oblique, semi-internal; teeth $\frac{1}{1}$, $\frac{2}{2}$, $\frac{2}{2}$, the laterals sometimes wanting; muscular impressions rough. Animal with the mantle open; siphons two, simple; foot cylindrical, pointed, slightly heeled.

L. borealis.
divaricata.
ferruginosa.
L. flexuosa.
leucoma.
spinifera. Fig. 105; $\frac{1}{2}$ *n. s.*

FAMILY III. CARDIADÆ.

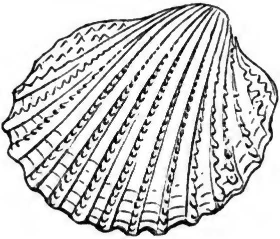
Shell regular, heart-shaped, marked with alternate ribs and furrows, radiating from the beaks;

ligament external, prominent; pallial line slightly sinuated; muscular impressions square. Animal with mantle open in front; siphons two, very short, thick, fringed; foot large, hooked.

Cardium (Linn.). *Cockle.* Shell swollen; beaks nearly central, prominent, margins indented; teeth $\frac{1}{1}$, $\frac{2}{2}$, $\frac{1}{1}$.

C. aculeatum.
echinatum. Fig 106; $\frac{2}{3}$ *n. s.*
rusticum.
edule.
fasciatum.

C. nodosum.
Norvegicum.
pygmæum.
Suecicum.



106

107

108

TRIBE II. ASIPHONIDA.

Hinge composed of many teeth .	*Arcadæ.*
Hinge nearly or quite toothless.	
Two muscularimpressions:	
Covered with dense epidermis .	*Mytilidæ.*
Without epidermis	*Aviculadæ.*
One muscular impression .	*Ostreadæ.*

FAMILY I. ARCADÆ.

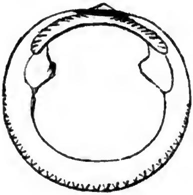
Shell equal-valved, covered with a dense epidermis; hinge forming a large portion of the margin, composed of a great number of similar comb-like teeth, placed side by side; muscular impressions nearly equal; pallial line distinct. Animal with the mantle freely open; generally without siphonal tubes; foot large, deeply grooved, and capable of expanding into a disk.

Leda (Schum.). Shell oblong, rounded in front, drawn out to a point behind; margins smooth; pallial line slightly sinuated.

L. caudata. Fig. 107; *n. s.*
pygmæa.

Nucula (Lamk.). Shell three-sided, covered with an olive epidermis, pearly within; margins notched; pallial line simple; hinge with prominent internal cartilage pit, and a row of teeth on each side.

N. decussata.
nitida.
nucleus. Fig. 108; *n. s.*
N. radiata.
tenuis.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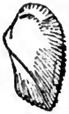
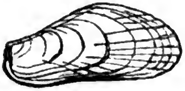

110

Pectunculus (Lamk.). Shell round, equal-sided, nearly smooth; teeth arranged in a semicircle.

P. glycimeris. Fig. 109; $\frac{2}{3}$ *n. s.*

Arca (Linn.). *Ark.* Shell solid, somewhat four-sided, marked with strong ribs, often crossed by furrows, commonly covered with a dense fibrous epidermis; teeth arranged in a straight line, very numerous.

A. barbata.
  lactea. Fig. 110; *n. s.*
  raridentata.
  tetragona.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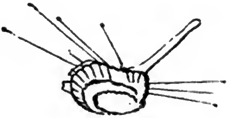

112

Family II. Mytilidæ.

Shell equal-valved, very unequal-sided, the beaks placed far in front, clothed with a dense epidermis; ligament internal, linear; hinge toothless; interior surface pearly; the fore muscular impression small, narrow; the hind one large. Animal attached at will by a byssus; mantle-edges united between the orifices, which do not form siphons; foot cylindrical, grooved.

Modiola (Lamk.). *Horse-Mussel.* Shell oblong, inflated in front; beaks blunt; epidermis often fringed.

M. modiolus. Fig. 111; ⅔ *n. s.*
  barbata.
  nigra.
M. phaseolina.
  tulipa.

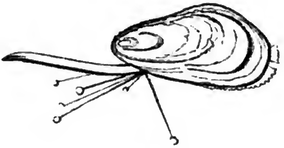
Crenella (Brown). Shell short and swollen, partly smooth, partly marked with radiating lines;

hinge-margin notched behind the ligament; interior brilliantly pearly. Animal crawls freely about sea-weeds by means of its long foot.

C. costulata.
  discors. Fig. 112; *n. s.*
  decussata.
  discrepans.
C. faba.
  marmorata.
  rhombea.

Mytilus (Linn.). *Mussel.* Shell wedge-shaped, round behind, the beaks forming a sharp point in front.

M. edulis. Fig. 113; $\frac{1}{3}$ *n. s.*



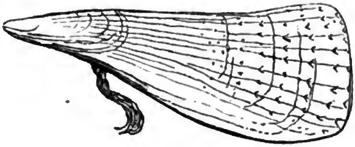
113

FAMILY III. AVICULADÆ.

Shell unequal-valved, very unequal-sided; the beaks near the front; epidermis wanting, or indistinct; interior generally pearly; hind muscular impression large, nearly central; fore one small, within the beak; pallial line reduced to a series of dots; hinge line straight, lengthened, wholly or nearly toothless. Animal with the mantle not adhering to the valves, entirely open, prolonged into irregular lobes without siphons, the edges fringed; foot small, grooved, spinning a strong byssus.

Pinna (Linn.). Shell wedge-shaped, horny, fragile; truncate behind; the beaks forming a point in front; hinge toothless. Animal with the mantle-edge doubly fringed; foot long, grooved, spinning a powerful silky bissus.

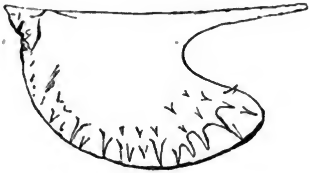
P. pectinata. Fig. 114; $\frac{1}{5}$ *n. s.*



114

Avicula (Brug.). *Wing-shell.* Shell wedge-shaped; the hinge-line straight, prolonged at the sides into wing-like processes; hinge-teeth one or two, minute.

A. tarentina. Fig. 115; $\frac{1}{2}$ *n. s.*



115

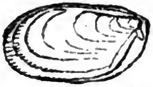
FAMILY IV. OSTREADÆ.

Shell unequal-valved, nearly equal-sided, often adhering to other bodies by one valve; epidermis inconspicuous; beaks central; ligament internal;

hinge usually toothless; one muscular impression only, placed behind the centre; pallial line obsolete. Animal with the mouth widely open, scarcely adherent to the shell; no siphons; foot often wanting; where present, minute, and capable of spinning a byssus in early age.

Lima (Brug.). Shell oblique; front side straight, gaping; hind side rounded, closed; beaks separate, produced into ear-like lobes; hinge toothless; cartilage internal, in a central pit. Animal with the mantle-edges double, the inner one hanging like a curtain, fringed with long tentacles; foot finger-like, grooved.

L. hians. Fig. 116; $\frac{1}{2}$ *n. s.*
Loscombii.
L. subauriculata.



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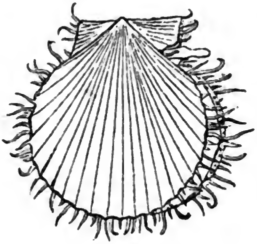


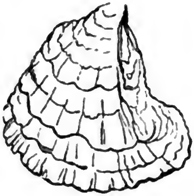
117

Pecten (Müller). *Scallop.* Shell round, nearly equal-sided, resting on the right valve, which is the more convex, marked with radiating ribs; beaks central, close together, produced into ears. Animal as *Lima*, but with conspicuous gem-like eyes along the outer edges of the mantle.

P. Danicus.
maximus.
P. similis.
striatus.

P. niveus. P. tigrinus.
opercularis. Fig. 117 ; ½ *n. s.* varius.
pusio.

118



119

Anomia (Linn.). *Perforate Oyster.* Shell roundish, thin, transparent, pearly ; left valve convex ; right flat, perforated or notched close to the hinge, the muscle passing through this hole to be inserted into a plate, which is cemented to foreign bodies.

A. aculeata.
ephippium. Fig. 118 ; ½ *n. s.*
patelliformis.

Ostrea (Linn.). *Oyster.* Shell very unequal-valved, the left being convex, the right flat ; the left valve is usually cemented to rocks, or to other shells ; surface irregularly plaited, with free edges ; hinge toothless.

O. edulis. Fig. 119 ; ⅓ *n. s.*

CLASS IV. BRACHIOPODA.

(LAMP-SHELLS.)

THE most prominent characteristics of this Class are indicated by the two appellations by which we have designated them above. The name of Lamp-shell refers to the close resemblance to an antique terra-cotta lamp, presented by the upper or ventral valve of one of these shells,—a *Terebratula*, for example. Here we have a bivalve, which is equal-sided, but very unequal-valved, one valve only having what would be called a beak in the CONCHIFERA; this projects beyond the extremity of the other valve, and curves upward (if we consider it as a lamp) or downward (if we regard the natural position of the shell). This beak is perforated with a hole corresponding to that which supports the wick in the lamp, but here subserving the purpose of a passage for a muscular stem that passes through it from the interior, and is affixed to the rock or other supporting body.

The smaller (or dorsal) valve has no beak nor perforation; it is articulated to its fellow by an apparatus of teeth and sockets, allowing of a marginal separation to a very small extent. Generally both valves are convex, but sometimes the dorsal valve is flat, or even very concave, as in the fossil family *Productadæ*.

In outline the *Brachiopoda* most commonly assume a form nearly circular, with the exception of the projecting beak; but in many cases the hinge-line is produced in a straight line to such an extent as to make the valves more or less semicircular; occasionally the outline is somewhat triangular, and not rarely two-lobed.

The shell in most of the genera is perforated by tubular canals passing directly from one surface to the other, and opening internally by minute orifices, externally by trumpet-shaped, or sometimes, as in *Crania*, by many-branched mouths. As to its structure, it is composed of flattened prisms, arranged obliquely to the thickness of the valve. A few genera are composed almost wholly of a horny animal substance; but in general the earthy element predominates even to a greater degree than in the CONCHIFERA.

The term BRACHIOPODA, signifying "arm-footed," is now too generally adopted to be conveniently changed, but the notion conveyed by it is only partially true. It was intended to express the most remarkable character of these animals, the presence of a pair of arms, often of great length, rolled up in a spiral form, which were believed by Cuvier to replace the foot in other bivalves. They are, however, now understood to be the palps immensely prolonged. Professor Owen has shown* that these organs are tubes closed at each end, and contain a fluid, which, by the contraction of the circular muscular fibres of which the walls of the tube are composed, is propelled from the base to the extremity, thereby unrolling, as he believes, the spiral coils. Whether this process of expansion and protrusion is the means by which the animal secures its food, or whether it really takes place at all in the natural and healthy condition of the animal, remains, we believe, still to be proved by actual observation of its manners.

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* Trans. Zool. Soc. vol. i. (1835).

One side of each arm is fringed with a vast number of long filaments, which are probably ciliated. In some fossil species, as the *Spiriferadæ*, the arms were permeated by an internal spire of shell, of very numerous whorls; while in some recent species, they are supported by a shelly process, which, springing from each side of the dorsal valve, proceeds towards the margin of the shell, then bending upward towards the opposite valve, turns back upon itself, and forms a *loop* in the centre of the cavity. This loop, being elastic, is supposed to aid in the opening of the valves; for, being slightly compressed when they are closed, they exert a pressure against the roof of the ventral valve, and thus supply the place, in some degree, of the tough and elastic ligament of the CONCHIFERA, which is here entirely wanting.

It appears, however, that the opening and clos ing of the valves are more effectively provided for, in the action of certain proper muscles, which are antagonistic to each other. Four pairs of muscles are inserted into the hollow of the ventral valve, two pairs of which go across to the other valve, and are inserted *in front* of the line which unites the hinge-teeth. These answer to the *adductor* muscles of the CONCHIFERA, as their contraction draws the valves towards each other. Two other pairs pass to that part of the dorsal valve which lies *behind* the hinge-line; and these by their contraction separate the margin of the valves.

The BRACHIOPODA are never free, but invariably attached to other bodies, occasionally, as in *Crania*, by the whole breadth of the ventral valve, but commonly by a muscular foot-stalk passing through the perforated beak. In general this stalk is only long enough to allow the dorsal valve room to lie upon or hang against the supporting body; but in some species, as in the genus *Lingula*, it is six or seven times as long as the shell.

Between the bases of the arms is concealed the mouth, which leads to a digestive canal more or less complex, and of varying length. The discharging orifice is usually near the perforation.

The valves, like those of the CONCHIFERA, are lined with the leaves of a fleshy mantle, the margins of which carry, in lieu of flexible tentacles, a fringe of stiff brittle bristles, which project beyond the edges of the valves, and are probably organs of touch. Besides the office of secreting the shell, the mantle in this Class performs the function of respiration by its internal surface. The mantle-leaves are also permeated by ample blood-vessels, which ramify through them.

Little is known, as yet, of the nervous system in these animals; and scarcely more of the phenomena of their reproduction. The ovaries in some cases surround the ramifications of the blood-vessels within the mantle, and in others occupy large cavities on each side of the body. Some facts seem to indicate that the young fry are hatched within the valves of the parent; but what is their first form, and what the extent of their metamorphoses, we are ignorant.

All the known species of the Class are marine, but comparatively few exist now, the great majority being fossil. Its British representatives are very few, extending only to five species.

Localities, &c.—Some species are occasionally found in rock-pools, and at the verge of low water; but the depths of the sea are the proper home of the BRACHIOPODA. A hundred fathoms' depth is no uncommon residence for these animals; and one species, *Crania personata*, has been dredged up from a depth of 255 fathoms!

Identification.—The chief particulars to be attended to in the identification of our recent species, are—the general form of the valves; the mode of their attachment; the sculpture or markings of the exterior; the nature of the hinge; the form of the shelly frame-work of the arms; the muscular impressions, or those produced by the insertions of the muscles; the vascular impressions, or those which correspond on the interior of the valves to the blood-vessels of the mantle; the form of the fringed arms, and the manner in which they are folded.

Authorities.—For structure, I have depended chiefly on Professor Owen's "Memoir on the Anatomy of the Brachiopoda," and on Mr. S. P. Woodward's "Manual of the Mollusca;" for the British species, Messrs. Forbes and Hanley are my authority.

BRACHIOPODA.

Molluscous animals enveloped in a shell of two valves, of which one is commonly perforated, attached to extraneous substances by a stalk passing through the perforation; valves applied, the one to the back, the other to the belly; mantle two-leaved, performing respiration, permeated by blood-vessels, and fringed with stiff, straight, horny bristles; no siphons; no head; mouth seated between two long, spirally coiled, fringed arms, which are supported by a calcareous frame-work.

Attached by the lower valve	*Craniadæ.*
Attached by a footstalk:	
Vascular impressions branched; arms supported by two minute plates	*Rhynchonelladæ.*
No vascular impressions; arms supported by a shelly loop	*Terebratuladæ.*

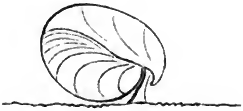
Family I. Craniadæ.

Shell roundish, hingeless, attached by the whole breadth of the ventral valve; dorsal valve limpet-shaped; interior of each valve with a broad granulated border; vascular impressions like the teeth of a comb. Animal with free spiral arms, supported by a nose-like prominence in the middle of the lower valve; mantle plain.

Crania (Retzius). Point of dorsal valve nearly central; arms thick, fringed, arranged in a horizontal coil of two or three turns.

C. anomala. Fig. 120; *mag.*

120



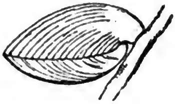
121

Family II. Rhynchonelladæ.

Shell somewhat three-sided, attached by a footstalk; ventral valve beaked; valves convex, articulated; hinge-line curved; vascular impressions branched dichotomously. Animal with long arms coiled in conical spires of many turns, directed towards the dorsal valve, not supported by a shelly framework; mantle fringed with a few short bristles.

Hypothyris (Phillips). Shell sharply beaked, plaited; dorsal valve elevated in front, depressed at the sides; ventral flattened; hinge-plates supporting two slender curved pieces.

H. psittacea. Fig. 121; *n. s.*



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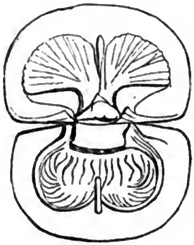


123

FAMILY III. TEREBRATULADÆ.

Shell rounded or ovate, attached by a footstalk; ventral valve with a prominent beak, and two curved hinge-teeth; dorsal valve with a prominent process between the hinge-sockets. Animal with arms united to each other by a membrane, supported by a shelly loop.

Terebratula (Brug.). *Lamp.* Shell round; perforation small, circular; loop short, simple, attached by its branches to the hinge-plate. Animal with the arms folded on themselves, spiral at the tips.

T. caput-serpentis. Fig. 122; *n. s.*
cranium.

Argiope (Deslongch.). Shell broad, semi-oval; hinge-line wide and straight; perforation large; interior of dorsal valve with several partitions; loop two or four lobed, adhering to the partitions. Animal with the arms folded into two or four lobes, united by a membrane, not spiral.

A. cistellula. Fig. 123; *mag.*

CLASS V. PTEROPODA.

CONSIDERED numerically, this Class is perhaps the least important in the animal kingdom, as it comprises but a very few species, either recent or fossil, and those of small size. Of these the British seas have hitherto yielded but five, neither of which can be considered other than as an accidental straggler to our shores. They are all, in fact, oceanic; unlike the BRACHIOPODA, which are always fixed, these are invariably found swimming at large in the open sea, being unprovided with any means of attaching themselves even for a moment, or of crawling on a solid support.

The most prominent character in this Class is the possession of two broad muscular fins, one on each side of the neck, somewhat resembling the expanded wings of a butterfly, whence Cuvier gave them the name of PTEROPODA, or "wing-footed."

An advance in structure above the molluscous animals already considered is shown in the presence of a distinct head, with tentacles, and jaws, and various organs of sense. In *Clio*, whose anatomy has been most investigated, there is an extraordinary apparatus developed for seizing its minute prey. On each side of the mouth are three fleshy warts, covered with minute red specks. Under a powerful microscope these specks, which number about three thousand on each tentacle, are seen to be transparent cylinders, each containing in its cavity twenty stalked disks, which may be protruded from their common sheath, and form so many adhesive suckers adapted to seize and hold the minute objects with which they come into contact. As there are six tentacles, and each tentacle bears 3,000 sheaths, and each sheath contains 20 suckers, it follows that there must be an array of 360,000 distinct organs capable of being brought into play by a *Clio* in the act of seizing its prey.

In the same animal there are a pair of jaws and a tongue. Each of the former is a straight stem, from one side of which project a series of arched spines, so graduated in length that their points reach the same level. The prey seized by these many-toothed jaws is then taken hold of by the tongue, which is a band covered with rows of minute spines hooked backwards.

Some of the species have the head and its organs less distinct.

Below the swimming-fins depends an oblong body, which in some genera is enclosed in a delicate shell of glassy transparency, varying in shape in different species. Sometimes, as in *Hyalea*, it resembles the two valves of a bivalve united at the hinge, but narrowly open at the sides and front. At other times, as in *Cleodora*, the sides are united, and there is only a front opening. In *Limacina* and *Spirialis*, again, it is a cone spirally twisted, like that of a Snail, but in a reverse direction. In those species which have a two-valved shell, the valves are placed against the back and belly, as in the BRACHIOPODA, and not on the right and left sides, as in the CONCHIFERA.

Authorities, &c. — To Cuvier's "Mémoires sur l'Histoire et l'Anatomie des Mollusques;" to Van Beneden's "Exercices Zootomiques" (Brussels, 1839); to Eschricht's "Anatomische Untersuchungen über die Clione borealis" (Copenh., 1838); and to Rang and Souleyet's "Histoire Naturelle des Pteropodes" (Paris, 1852); we are indebted for nearly all our knowledge of the structure and affinities of these little animals.

PTEROPODA.

Molluscous animals provided with a head, and with two muscular fins, by which they swim at large in the sea; sometimes partly enclosed in a glassy shell.

Animal furnished with a shell:	
Shell symmetrical, two-valved . .	*Hyaleadæ.*
Shell spiral, with an operculum. .	*Limacinadæ.*
Animal destitute of a shell . . .	*Clionidæ.*

FAMILY I. HYALEADÆ.

Animal furnished with an external shell; head indistinct; foot and tentacles rudimentary; shell symmetrical, globose, formed of two plates.

Hyalea (Lamk.). *Glass-shell.* Shell slit at the sides and front, three-pointed behind.

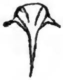
H. trispinosa. Fig. 124; *n.s.*

FAMILY II. LIMACINADÆ.

Animal with a spiral, snail-like, but sinistral shell; head indistinct; fins attached to the sides of the mouth, united ventrally by a lobe.

Spirialis (Souleyet). Shell minute, furnished with a thin, glassy, crescent-shaped operculum, seated on the ventral lobe. Animal with narrow fins, plain at their edges.

S. Flemingii. Fig. 125 ; *mag.*
Jeffreysii.
Macandrei.



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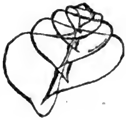

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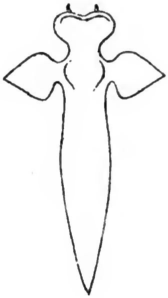

126

Family III. Clionidæ.

Animal without shell or mantle; head distinct, armed with tentacles; body tapering; foot small, two-lobed.

Clio (Linn.). Head furnished with two eyes and two tentacles; mouth armed on each side with three conical warts, bearing numerous minute suckers.

C. borealis. Fig. 126 ; *n. s.*

Class VI. GASTROPODA.

(Snails and Slugs.)

The under side of the body in this extensive Class forms a flat, usually broad, fleshy disk, which is the organ of locomotion. Every one is familiar with the mode in which a Snail or a Periwinkle glides along on this broad "belly-foot;" and, by watching the motion on the opposite side of a plate of glass, we readily discern the minute wrinkles produced by the contraction of numerous muscular fibres in succession, which proceed from the hind parts forward in waves, by which means the foot slides uniformly along over solid bodies.

The upper parts, in the majority of species, are covered with a fleshy cloak or *mantle*, the edges of which are free, in a greater or less degree, and in some cases are expanded into great lateral wings. In the Sea-hare (*Aplysia*), these expansions serve, by their waving motion, as swimming-fins. The proper function of the mantle-edge is, however, the formation and increase of the shell; and hence it is always found, in shell-covered species, on that part of the body which is near the orifice. In a few species, the shell is included within the substance of the mantle.

A distinct *head* is always present, more or less conspicuous according to the degree in which it projects from beneath the front of the mantle. It is furnished with various organs of sense.

The organs of *touch* are one or two pairs of contractile tentacles, placed commonly on the back of the head. In some cases these can be inverted and everted; but more generally they are solid. The hinder pair, where there are two, are often more complex in structure than the others, and are, perhaps, the seat of the sense of *smell.*

Well-developed *eyes* are almost invariably present in this Class. They never exceed a single pair, and are generally placed on some part of the tentacles,—the hinder ones, when there are two pairs. The most common position for these organs is at the extremity of a short fleshy column, springing from the base of the tentacle. In many species the eyes present an elaborate structure; the great *Strombidæ* of the tropical seas, for example, have eyes with "a distinct pupil and a double iris, equalling, in beauty and correctness of outline, those of birds and reptiles;"* and many of our native genera, as *Buccinum*, *Fusus*, and *Murex*, are scarcely inferior, in this respect, to the *Strombidæ.*

The organs of *hearing* are as rudimentary as in the CONCHIFERA. They are variously placed in different genera, but most commonly on the upper side of the great brain-ganglion, near the eyes (as in the *Nudibranchia*), or on the lower side of the neck, and consist of a pair of transparent capsules, filled with a clear fluid, in which are suspended one or more glassy bodies, called *otolithes* (ear-stones). The number of these bodies sometimes reaches to eighty in each capsule. Their movements "are even more marked than in the CONCHIFERA; and the balancing and rotating of each, producing a kind of trembling of the whole mass which occupies the centre of the capsule, is a wonderful spectacle. It has been recently discovered that these motions are due to very small cilia upon the internal surface of the capsule." *

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* Guilding.

The *nervous system* varies in its development in the genera of GASTROPODA. The central portion consists of a group of ganglions, set near together, surrounding, like a ring, the gullet. In many genera, the ganglions which form the upper part of the ring are blended together, and constitute a brain; while on the opposite (or lower) side of the ring, there is also another large mass of grouped or blended ganglions. From this ring nervous threads pass in various directions to the organs of sense, along the foot, &c., in some cases connecting themselves with other ganglions, which form centres of communication to the stomach and other organs.

There is always in these animals a distinct *mouth*, placed at the front of the head, furnished with swollen, contractile lips, often prolonged into a cylindrical proboscis. In many species, as in *Eolis*, *Tritonia*, &c., there are two horny, sharp-edged plates, which act as *jaws*, playing over each other, like the blades of shears. Sometimes there is only a single jaw-plate inserted in the palate.

There is, beside the jaws, a fleshy band, longer or shorter according to the genus, which performs the function of a tongue. It is sometimes grooved along its surface, and is always armed with horny *teeth* or spines, which are arranged in regular rows, both longitudinally and transversely. The form, number, and pattern of these teeth vary greatly, though always constant in the same species. They "are amber-coloured, glassy, and translucent; and being siliceous (they are insoluble in acid), they can be used like a file for the abrasion of very hard substances. With them the Limpet rasps the stony nullipore, the Whelk bores holes in other shells, and the Cuttlefish doubtless uses its tongue in the same manner as the cat."* In each transverse row, there is generally a variously-toothed plate, pointing backwards, and overlapping the base of its predecessor; while on each side of this there are several lateral teeth in the form of curved spines, which arch inwards. The tongue of the Limpet is longer, when extended, than the whole animal; that of the Whelk has a hundred rows of teeth; while the great Slug has one hundred and sixty rows, with one hundred and eighty teeth in each row.†

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* Siebold's Comp. Anat.; § 211.

The stomach is sometimes armed with horny plates and teeth, as in the Sea-hare (*Aplysia*), which feeds on leathery *Fuci*. The intestine usually opens by an orifice on the right side of the animal, not far from the head. In the *Doris*, the orifice is in the middle of the back, and in the *Chiton* it is at the hinder extremity of the body.

A colourless blood, very deficient in the disks which form in general so conspicuous a portion of this fluid, circulates in the GASTROPODA. A *heart* is always present, divided into two chambers,—a very muscular *ventricle*, and a thin-walled *auricle*. It is generally situated at the base of the breathing organs, on the right side. The blood passes from the gills into the auricle, and thence into the ventricle, whence it is forced to all parts of the body. The circulation is not, however, always through a series of vessels, the arteries being frequently wanting, and also the veins to a certain extent. The blood finds its way into cavities without walls, excavated out of the flesh of the body.

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* Woodward's Manual of the Moll. 27.

† Ibid. 28.

With all the species of the Class that are included in the plan of this work, the respiration is aquatic, and performed by means of *gills*. These are composed of parallel plates, or of threads arranged in rows, or in bundles, or more generally in the form of a comb or of a feather. Whatever the form, the surface is densely clothed with vibrating cilia, by whose motions the water is passed in incessant currents over the breathing organ. The gills are generally situated on the right side, in a special cavity, but sometimes, as in *Pleurobranchus*, they lie in the angle formed by the mantle and the foot, or, as in the *Dorididæ*, &c., they are quite exposed, on the surface of the body.

Although some of the GASTROPODA are quite naked, the majority are protected by a calcareous *shell*, which is invariably, except in one family, formed of a single piece, and hence is often called, though somewhat incorrectly, *univalve*. The exception is that of the *Chitonidæ*, or Coat-of-mail Shells, in which the shell consists of eight transverse plates, imbedded in the mantle. The ordinary form is that of a cone, which is sometimes low and nearly symmetrical, as in the Limpets, but more ordinarily drawn out to a great length, and rolled on itself, so as to form a spire. The spire is almost always rolled *dextrally*,—that is, from east to south. Accidental specimens are occasionally found, which turn in the opposite direction, termed *sinistral,* or reversed, and in a few instances this is the natural figure of the species. The axis around which the spire is rolled may be hollow, when the shell is *umbilicate;* or solid, when it is *pillared.* That edge of the orifice which is formed by the margin of the shell is the *outer* lip; that which is formed by the pillar is the *inner* lip.

In the carnivorous GASTROPODA, the base of the shell is grooved to form a *canal,* through which the proboscis is protruded; but the canal may be merely a notch, or lengthened into a long gutter.

The shell is formed in the same manner as in the CONCHIFERA, by the folding back of the edge of the mantle. This edge in some species has projections which secrete shelly matter, producing spinous processes, ribs, knobs, or other irregularities on the surface or on the margin of the shell. Occasionally the two sides of the mantle are bent upwards, embracing more or less completely the shell, in which case the exterior is covered with a glassy, porcelain-like coat; this is the case with the well-known and beautiful Cowries (*Cypræadæ*).

Very many species carry on the hinder part of the body a horny or shelly plate (*operculum*), which accurately closes the aperture of the shell, when the animal has withdrawn into its recesses. The form of this appendage is ordinarily that of a very flat cone, made by successive layers, each a little larger than its predecessor, or a flattened spire. The common Top-shells (*Trochus*) afford good examples of the spiral operculum.

The shells of this Class of animals are among the most beautiful of natural objects; and when we consider that they are prepared for the cabinet without difficulty, preserved without expense, and free from any liability to decay, we cannot wonder at the ardour with which they have been collected, or the miser-like avidity with which they have been guarded.

For the gorgeously coloured treasures of the Indian Seas prices almost fabulous have been given. The sacrifices that wealthy collectors in former days "have made to procure a fine and perfect Many-ribbed Harp, a Gloria maris, or Cedo nulli among the Cones, an Aurora, or Orange Cowry, a Voluta aulica, or Voluta Junonia, &c., are only comparable to the extravagances of those visited by the tulip-mania, when it was at its height." * The shells of our coasts are mostly small and inconspicuous, compared with those tropical glories; and yet there are not wanting with us, in the genera *Acmea*, *Trochus*, *Phasianella*, *Rissoa*, *Eulima*, *Chemnitzia*, *Cypræa*, &c., specimens worthy of high admiration for beauty of colour, delicacy of sculpture, brilliance of surface, or elegance of contour.

The sexes in some species are united in one individual; in others they are distinct. In either case the eggs of the marine kinds are deposited in numbers together, enveloped in a common mass of jelly. Those of the Nudibranchs are arranged either in broad frilled ribbons attached by one edge, and coiled spire within spire, as in the *Dorididæ*, or in long threads variously twisted, as in the *Eolididæ*. As an example of the number deposited, I may mention that a specimen of *Eolis papillosa* has this spring laid, in one of my tanks, nine strings of spawn, between the 20th of March and the 24th of May, all as nearly as possible of the same length. Each string contains about 100 convolutions, each convolution about 200 ova, and each ovum including on an average two embryos, making a total progeny of 360,000, produced from one parent in little more than two months.

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* Penn. Cyclop.; art. MALACOLOGY.

The young, when hatched, have a minute transparent nautilus-shaped shell, from which protrudes a head furnished with a pair of large swimming-fins, so that they may be compared with the PTEROPODA. The fins are richly ciliated, and by their vibration the little animal is capable of swimming with great swiftness.

With a slight exception, this is the infant stage of all the marine GASTROPODA, however diverse the form of the adult. They all, therefore, undergo a metamorphosis. The exception alluded to is that of the *Chitons*, whose early stage, as recently shown by the observations of Mr. Clark and Professor Lovén,* is peculiar, and more resembling that of an Annelid than of a Mollusk. In this case, the animal can scarcely be said to undergo a metamorphosis; for the embryo, even within the egg, has nearly the form of the parent, and the appearance of the shell-plates is a matter of development.

Localities, &c.—Almost every variety of shore, and every range, from high-water mark to the deep sea-bottom, is tenanted by some members of this Class. The pretty, many-coloured Ridged Winkle (*Littorina rudis*), congregates in hollows of the rock, scarcely within reach of the spray, except at spring-tides; the Limpet adheres by thousands but a little lower; on the boulders, about half-tide level, the Purple (*Purpura*) and one or two species of *Trochus* may be seen; lower still, to the verge of extreme low-tide, we find the purple-spotted Trochus (*T. ziziphinus*), the ridged and furrowed Rock-shell (*Murex*), the Dog-Winkle (*Nassa*), the Chitons, looking like the Millepedes of our gardens, and the lovely little Cowry, enveloped in its variegated mantle. If we turn over stones at the water's edge, especially in spring, we may find the Sea-lemon (*Doris*), the lovely *Eolis coronata*, and other species of Nudibranchs, which resort thither to lay their coils of spawn, the *Pleurobranchus*, and the great purple Sea-hare, which stains the stones with its rich crimson dye.

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* See Ann. and Mag. of Nat. Hist. for Dec. 1855, and May 1856.

Many species may be found among the seaweeds. On the tangled masses of the Bladder-weed, the Yellow Winkle and several of the Tops occur by thousands; the common Periwinkle haunts the conferva-clad mud, as well as weedy rocks; and by gathering tufts of *Corallina*, *Ceramium*, and other small but bushy *Algæ*, and shaking them into a basin of water, we may obtain crowds of tiny *Rissoæ* and their allies, together with the beautiful *Phasianella*, and such-like small beauties. The lustrous little Blue-lined Limpet (*Pat. pellucida*) is found in cavities, which it has eaten out of the massive stems and roots of the Tangle.

The *Ianthina*, with its curious apparatus of swimming-bladders, floats on the surface of the wide ocean, and is a mere visitor to us. But from the sea-bottom the dredge gathers many species. On a sandy ground the tusk-like *Dentalium*, the polished *Naticæ*, the Wentletraps, and the different sorts of *Bulla* are found, as most of these have burrowing habits. If the bottom be rough and stony, the great Whelks and Spindles, the Pelican's-foot (*Aporrhais*), the *Turritella*, and many others, come up in the dredge. But the richest ground of all is an old Oyster or Scallop bed, where we may obtain the curious Cup-and-saucer (*Calyptræa*), the Keyhole Limpet (*Fissurella*), the Notched Limpet (*Emarginula*), the Torbay Bonnet (*Pileopsis*), and many others of interest, adhering to the old shells, among the zoophytes, stars, and worms, which throng such prolific localities.

Identification.—The most prominent points for discriminating the genera are these. The presence or absence of a shell; its form; the direction of its spire; the presence of an operculum; its substance; its mode of formation; the presence or absence of a proboscis; the extent of the mantle; the number and shape of the tentacles; the form and position of the gills; the extent and form of the foot; the nature of the shell-axis; the position of the eyes; and finally the tongue, its comparative length and breadth, and the form and arrangement of its teeth.

Authorities.—These are the same as those cited for the CONCHIFERA.

GASTROPODA.

Molluscous animals furnished with a distinct head, and a fleshy crawling foot; either naked or protected by a shell, for the most part formed of a single piece, and generally spirally turned; mouth provided with lips, and a ribbon-like tongue, armed with rows of teeth; eyes two; tentacles two or four. Young subject to metamorphosis.

Gills exposed; shell rudimentary or wanting; sexes united	*Opistho-branchiata.*
Gills enclosed in a vaulted cavity; shell capacious; sexes distinct . .	*Proso-branchiata.**

Order I. OPISTHO-BRANCHIATA.

Shell rudimentary or wanting; gills disposed in tufts (*fasciculated*), or branching (*arborescent*), not contained in a spiral cavity, but more or less completely exposed on the back and sides, towards the hinder part of the body; sexual functions united in the same individual. Feeding principally on zoophytes.

No shell, except in the infant state; gills external, on the back or sides .	*Nudibranchiata.*
Shell usually present throughout life; gills covered by the shell or mantle	*Tectibranchiata.*

TRIBE I. NUDIBRANCHIATA.

No gills	*Elysiadæ.*
Gills conspicuous.	
Arranged along the sides.	
Tentacles not retractile . . .	*Eolididæ.*
Tentacles retractile into sheaths	*Tritoniadæ.*
Arranged in a circle on the back .	*Dorididæ.*

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* The Order Pulmonifera contains no marine species.

Family I. Elysiadæ.

Without mantle or breathing organs; body covered with cilia; a single row of tongue-teeth; eyes sessile, on the sides of the head; tentacles simple or wanting.

Elysia (Risso). Slug-like, flattened, with lateral expansions; tentacles simple, in front of the eyes; foot narrow.

E. viridis. Fig. 127; *n. s.*

127

128

129

130

Actæonia (Quatref.). Head large, distinct, crested at the sides, the crests prolonged behind into two short tentacles, behind which are the eyes; vent in the middle of the back.

A. corrugata. Fig. 128; *mag.*

Cenia (Alder and Hancock). Head slightly angled, carrying two slender tentacles on its back; eyes behind and outside them; back elevated.

C. Cocksii. Fig. 129; *mag.*

Limapontia (Johnst.). Leech-like, low in front, rounded and elevated behind; head distinct, with two lateral crests, on which are the eyes; foot very narrow.

L. nigra. Fig. 130; *mag.*

FAMILY II. EOLIDIDÆ.

With gills in the form of lengthened warts (*papillæ*), arranged along the sides of the back; tentacles not retractile, without sheaths; tongue-teeth central, without laterals; skin smooth, without *spicula;* no mantle.

Eolis (Cuv.). Tentacles four, slender, the dorsal pair sometimes ringed; gills simple, cylindrical; tongue-teeth comb-like.

* Gills numerous, depressed, overlapping:

E. papillosa.
Alderi.
glauca.

** Gills clustered:

E. coronata. Fig. 131; *n. s.*
Drummondi.
rufibranchialis.
pellucida.
gracilis.
alba.
punctata.

E. smaragdina.
elegans.
carnea.
glaucoides.
lineata.
Landsburgii.

*** Gills in transverse, rather distant, rows:

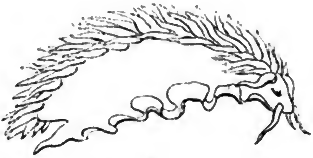
E. angulata.
nana.
concinna.
aurantiaca.
olivacea.
cingulata.
vittata.
Northumbrica.
viridis.
arenicola.
purpurescens.
cærulea.

E. picta.
tricolor.
Farrani.
amœna.
pustulata.
Peachii.
stipata.
inornata.
Couchii.
Glottensis.
amethystina.
exigua.

**** Gills in a single row on each side :

E. despecta.

131



132

Fiona (Alder and Hancock). Lengthened; tentacles four, all linear; gills clothing irregularly an expansion on the sides, and meeting behind; each papilla with a fringe along its inner side.

F. nobilis. Fig. 132 ; $\frac{1}{2}$ *n. s.*

Embletonia (Alder and Hancock). Tentacles two, simple; gills cylindrical, arranged in a single row on each side; head produced into a flat rounded lobe on each side.

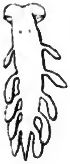
E. pulchra. Fig. 133 ; $\frac{4}{1}$.
minuta.
pallida.

Proctonotus (Alder and Hancock). Oblong, flattened, pointed behind; head covered with a crescent-shaped veil; gills ovate, placed along a ridge on each side, and round the head in front; vent on the back.

P. mucroniferus. Fig. 134 ; $\frac{2}{1}$.

Antiopa (Alder and Hancock). Oblong, pointed behind; dorsal tentacles ringed, and connected by an arched crest; gills and vent as in *Proctonotus*.

A. cristata. Fig. 135; *n. s.*
hyalina.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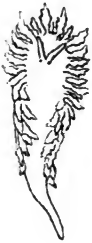
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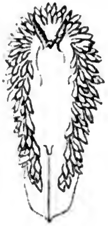

135

Hermæa (Lovén). Lengthened; tentacles two, ear-like, folded; gills lengthened, along the sides; vent near the fore part of the back; no jaws.

H. dendritica.
bifida. Fig. 136; *n. s.*

Alderia (Allman). Oblong, convex; head lobed; no tentacles; no jaws; gills in transverse rows along the sides of the back; vent on the hind part of the back.

A. modesta. Fig. 137; $\frac{2}{1}$.

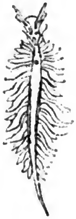
FAMILY III. TRITONIADÆ.

Gills simple or arborescent, arranged along the sides of the back; tentacles retractile into sheaths; tongue with one central, and numerous lateral teeth in each row.

Tritonia (Cuv.). Body lengthened, thick; tentacles two, branching; head with a warted or fringed veil; gills branching in a single row, on a ridge on each side.

T. Hombergi.
lineata. Fig. 138; $\frac{2}{1}$.

T. alba.
plebeia.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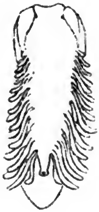
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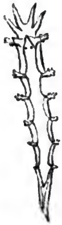

138

Scyllæa (Linn.). Body compressed; foot long, narrow, grooved; back with two pairs of lateral, wing-like lobes, bearing small tufted gills on their inner surfaces; tentacles two, with fringed tips; oceanic.

S. pelagica. Fig. 139; $\frac{2}{1}$.

Dendronotus (Alder and Hancock). Tentacles fringed with membranous expansions (*laminæ*);

head-veil with branched appendages; gills branched, in a single row on each side.

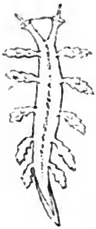
D. arborescens. Fig. 140 ; *n. s.*

Doto (Oken). Tentacles slender, simple; sheaths trumpet-shaped; veil simple; gills club-shaped or ovate, rough with warts, arranged in one row on each side; foot very narrow.

D. coronata. Fig. 141 ; $\frac{2}{1}$.
fragilis.
pinnatifida.

139

140



141

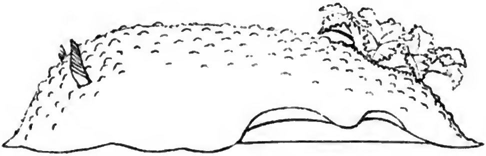
Lomanotus (Verany). Lengthened, slender, smooth; head veiled; tentacles club-shaped, laminated; gills slender, arranged along the waved edge of the mantle; foot slender, produced at the front into long lateral processes.

L. marmoratus. Fig. 142 ; $\frac{2}{1}$.
flavidus.

FAMILY IV. DORIDIDÆ.

Gills feather-shaped, placed in a circle around the vent on the middle of the back; tentacles two; tongue armed with lateral teeth, often very numerous, central tooth often wanting; skin strengthened with calcareous spicula, imbedded in its substance.

142



143

Doris (Linn.). Oval, depressed, or convex; mantle large, covering the head and foot; tentacles two, club-shaped, laminated, retractile within cavities; gills usually retractile into one or more cavities. Feed on sponges.

* Gill-plumes retractile within a single cavity:

D. tuberculata. Fig. 143; *n. s.*
flammea.
Johnstoni.
coccinea.

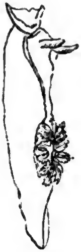
D. repanda.
planata.
Zetlandica.
millegrana.

** Gill-plumes retractile within separate cavities:

D. Ulidiana.
muricata.
aspera.
bilamellata.
depressa.
pusilla.
D. sparsa.
inconspicua.
proxima.
diaphana.
oblonga.

*** Gill-plumes not retractile:

D. pilosa.
D. subquadrata.



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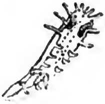


145

146

Goniodoris (Forbes). Oblong; mantle small, not covering the head and foot, simple; tentacles club-shaped, laminated, not retractile.

G. nodosa.
castanea. Fig. 144 ; $\frac{2}{1}$.

Triopa (Johnst.). Oblong; mantle margined with filaments; tentacles club-shaped, retractile within sheaths.

T. clavigera. Fig. 145 ; *n. s.*

Ægirus (Lovén). Oblong, covered with large warts; no mantle; tentacles slender, retractile within prominent lobed sheaths; gills branched, tree-like.

Æ. punctilucens. Fig. 146; *n. s.*

Thecacera (Fleming). Oblong, smooth; tentacles club-shaped; retractile within sheaths; head with a simple veil; gills feather-shaped, surrounded by a ring of warts.

T. pennigerum. Fig. 147; $\frac{3}{1}$.
virescens.
capitatum.

Polycera (Cuv.). Lengthened, smooth or warted; tentacles club-shaped, laminated, not retractile, not sheathed; veil edged with processes; gills feather-shaped, accompanied by club-shaped appendages.

P. quadrilineata.
Lessonii.
ocellata. Fig. 148; *n. s.*

147

148

Idalia (Leuckart). Oblong, broad, nearly smooth; mantle small, margined with filaments; tentacles with filaments at their bases; head slightly lobed.

I. aspersa. Fig. 149; $\frac{3}{1}$.
inæqualis.
Leachii.

I. quadricornis.
elegans.
pulchella.

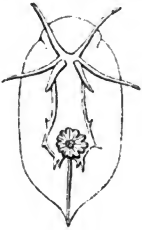
Ancula (Lovén). Slender, lengthened; mantle entirely adhering, its margin adorned with club-shaped filaments; tentacles club-shaped, laminated, with filaments on their stems.

A. cristata. Fig. 150; *n. s.*

TRIBE II. TECTIBRANCHIATA.

Shell (where present) enclosed within the flesh.

Shell a thin convex shield:	
Gill between the edge of the mantle and the foot	*Pleurobranchidæ.*
Gill in the back, beneath the shell	*Aplysiadæ.*
Shell globose or cylindrical, rolled	*Bulladæ.*
Shell external	*Tornatelladæ.*



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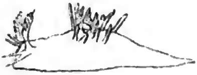


150

151

FAMILY I. PLEUROBRANCHIDÆ.

Shell wanting, or concealed within the substance of the mantle, protecting the intestines; gills feather-shaped, situated in the angle formed by the mantle and the foot. Food vegetable.

Runcina (Forbes). Minute, slug-like; mantle distinct; eyes sessile; no tentacles; gills three plumes beneath the mantle, on the right side of its hinder edge; shell wanting.

R. Hancocki. Fig. 151 ; $\frac{3}{1}$.

Diphyllidia (Cuv.). Oblong, fleshy; mantle ample; gills placed beneath the hind edge of the mantle, on both sides; head with a veil, and minute tentacles; shell wanting.

D. lineata. Fig. 152 ; $\frac{1}{2}$ *n. s.*

152

153

Pleurobranchus (Cuv.). Oval or roundish, fleshy; mantle covering the back and sides, and overlapping the foot; gill a single plume, beneath its right edge; tentacles two, grooved; a broad lobed veil; shell flexible, convex.

P. plumula. Fig. 153 ; *n. s.*
membranaceus.

FAMILY II. APLYSIADÆ.

Shell rudimentary, internal, thin, oblong, convex, slightly rolled at one end; head distinct, with tentacles and eyes; foot long, extending behind; sides expanded into wing-like lobes, turned up over the back; gill-plume concealed beneath the shell, in the middle of the back.

Aplysia (Gmelin). *Sea-hare.* Lengthened, elevated in the middle; head distinct, with four rolled, ear-like tentacles; mouth armed with horny jaws; tongue-teeth 13—1—13. Discharge a purple fluid.

A. punctata.[*] Fig. 154; $\frac{2}{3}$ *n. s.*

154

155

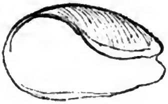
FAMILY III. BULLADÆ.

Shell globose or cylindrical, rolled like a scroll, with a minute spire, and a large aperture; outer lip sharp; no operculum; animal more or less investing the shell; head broad, flat, without distinct tentacles; foot furnished with two side-lobes and a hind-lobe; gill single, covered by the shell; food animal.

[*] The name "*hybrida*" of Sowerby, adopted by Forbes and Hanley, involves an absurdity, and should be rejected.

Philine (Ascan.). Shell fragile, translucent, white when dry, oval; aperture very wide; animal investing the shell; slug-like; head oblong, four-sided; no eyes; foot broad, with large side-lobes.

P. aperta. Fig. 155; *n. s.*
quadrata.
scabra.
catena.
punctata.
pruinosa.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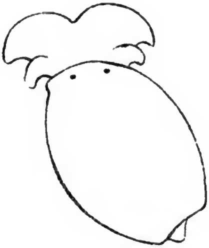

157

Scaphander (Montfort). Shell oblong, or ovate, rolled; spirally striated; spire concealed; aperture wide in front; covered by a thick epidermis. Animal with a large head; eyeless; foot short and broad; side-lobes turned up, but not enveloping the shell.

S. lignarius. Fig. 156; ½ *n. s.*

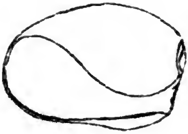
Amphisphyra (Lovén). Shell small, thin, ovate, truncate, with a long aperture, and a minute spire. Animal wholly retractile within the shell; head wide, with triangular tentacles; two minute sunken eyes.

A. hyalina. Fig. 157; *n. s.*

Cylichna (Lovén). Shell solid, cylindrical, rolled; truncate. Animal short and broad, not investing the shell; tentacle-lobes united.

C. cylindracea. Fig. 158; *n. s.*
conulus.
mammillata.
nitidula.
C. obtusa.
strigella.
truncata.
umbilicata.

158



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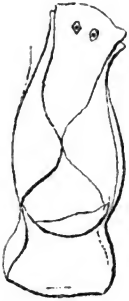

160

161

Acera (Müller). Shell thin, flexible, swollen; aperture long, expanded, and deeply notched in front; pillar open, exposing the whorls. Animal with a short, truncate head; no eyes; side-lobes nearly concealing the shell.

A. bullata. Fig. 159; *n. s.*

Bulla (Lamk.). *Bubble.* Shell swollen, rolled, partly or entirely external, perforated at the summit; lip sharp. Animal with a large head, two-lobed behind; side-lobes very large, turned up on the shell; hind-lobe covering the spire; foot four-sided.

B. Cranchii.
hydatis. Fig. 160; *n. s.*

FAMILY IV. TORNATELLADÆ.

Shell external, solid, distinctly spiral, with a narrow aperture, and a plaited pillar. Animal with a broad flattened head, and broad tentacles; foot large, carrying an operculum.

Tornatella (Lamk.). Shell ovate, with a conical spire of many whorls; aperture rounded in front. Animal white; head notched.

T. fasciata. Fig. 161; *n. s.*

Order II. PROSO-BRANCHIATA.

Shell ample, usually capable of concealing the whole animal; mantle forming a vaulted chamber over the back, in which the gills are lodged; gills comb-shaped or feather-shaped, in front of the heart. Sexes distinct.

Shell with the front margin entire	*Holostomata.*
Shell with front margin notched or produced into a canal	*Siphonostomata.*

TRIBE I. HOLOSTOMATA.

Shell variously shaped; margin of the aperture entire; operculum usually spiral. Animal with a short muzzle, not retractile; breathing-siphon wanting, or formed by a lobe of the neck; neck and sides frequently adorned with appendages.*

Shell composed of eight plates .	*Chitonidæ.*
Shell tubular	*Dentaliadæ.*
Shell a low cone.	
Shell entire:	
Summit turned forwards . .	*Patelladæ.*
Summit backwards	*Calyptræadæ.*
Shell slit or perforated	*Fissurelladæ.*

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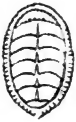
* *Aporrhais*, which by the preponderance of its characters belongs to this tribe, has a canal. *Natica* and *Scalaria* have a retractile proboscis. (Woodward.)

Shell spiral.*

Shell snail-shaped.	
Aperture very wide:	
Outer lip slit or perforated	*Haliotidæ.*
Outer lip entire	*Naticadæ.*
Aperture moderate:	
Interior pearly	*Trochidæ.*
Interior not pearly	*Littorinadæ.*
Shell lengthened:	
Aperture channelled	*Cerithiadæ.*
Aperture simple:	
Operculum spiral	*Turritelladæ.*
Operculum of successively enlarging plates	*Pyramidelladæ.*



162

163

FAMILY I. CHITONIDÆ.

Shell formed of eight transverse plates, lodged in a leathery mantle, which overlaps the body on all sides. Animal with a broad, oval foot; no eyes or tentacles; tongue long, narrow, with three series of teeth.

Chiton (Linn.). *Coat-of-mail Shell.* Shell-plates wider than long, overlapping.

C. albus.
asellus.
cancellatus.
cinereus. Fig. 162; *n. s.*
discrepans.
C. fascicularis.
Hanleyi.
lævis.
marmoreus.
ruber.

---

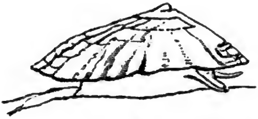
* *Cæcum* (*fig.* 184) in the *Turritelladæ* is tubular, resembling *Dentalium.*

FAMILY II. DENTALIADÆ.

Shell tubular, curved, open at each end, tapering; aperture circular. Animal attached to the shell near the hinder end; head indistinct, without eyes or tentacles; foot conical, with side-lobes; gills two, symmetrical; blood red.

Dentalium (Linn.). *Tusk-shell.* [Characters those of the Family.]

D. entalis. Fig. 163; *n.s.*
tarentinum.



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165

FAMILY III. PATELLADÆ.

Shell conical, with the summit turned forwards. Animal with a distinct head, eyes, and tentacles; foot as wide as the shell; gill-plume one, comb-like; tongue long, narrow, with numerous teeth.

Patella (Linn.). *Limpet.* Shell oval, with the summit more or less central. Animal with the gill-plume very long, surrounding the body, and attached throughout.

P. vulgata. Fig. 164; *n.s.*
pellucida.
athletica.

Acmæa (Esch.). Shell like that of *Patella.* Animal with the gill-plume lodged in a cavity on the neck, projecting from the right side.

A. testudinalis. Fig. 165; *n.s.*
virginea.

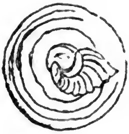
FAMILY IV. CALYPTRÆADÆ.

Shell limpet-shaped, the summit sometimes slightly spiral, directed backwards. Animal with a distinct head, eyes, and tentacles; muzzle lengthened; gill-plume single.

Calyptræa (Lamk.). *Cup-and-Saucer.* Shell round, conical; interior with a projecting plate on the hinder side, resembling half a cup. Animal with the mantle plain.

C. Sinensis. Fig. 166; *n. s.*

166



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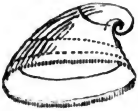

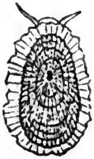

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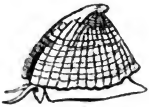
169



170

Pileopsis (Lamk.). *Bonnet.* Shell round, conical, with the summit recurved; interior simple. Animal with the mantle fringed.

P. Hungaricus. Fig. 167; ½ *n. s.*

FAMILY V. FISSURELLADÆ.

Shell limpet-shaped, summit turned backwards; a slit in the front margin, or a perforation at the summit. Animal with a distinct head, eyes, and tentacles; gill-plumes two.

Fissurella (Lamk.). *Key-hole Limpet.* Shell oval, conical, low, with the summit perforated.

F. reticulata. Fig. 168; ½ *n. s.*

Puncturella (Lowe). Shell conical, high, with the summit turned back; perforation in front of the summit.

P. Noachina. Fig. 169; *n. s.*

Emarginula (Lamk.). Shell high, with the summit turned back; front margin slit.

E. crassa.
reticulata. Fig. 170; $\frac{1\frac{1}{2}}{1}$
rosea.

FAMILY VI. HALIOTIDÆ.

Shell spiral, ear-shaped, or snail-shaped, with a wide aperture, the outer lip either perforated or slit. Animal with a short muzzle, tentacles, and eyes; gill-plumes two.

Haliotis (Linn.). *Ear-shell; Ormer.* Shell ear-shaped; spire minute, flat; aperture very wide, interior pearly; margin perforated with many holes. Animal with fringed lobes to the head and sides; no operculum.

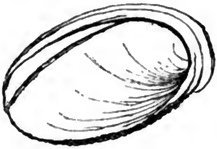
H. tuberculata. Fig. 171; ½ *n. s.*

Scissurella (D'Orb.). Shell thin, not pearly, globose; aperture rounded; outer margin slit. Animal furnished with an operculum.

S. crispata. Fig. 172; $\frac{6}{1}$.

Ianthina (Lamk.). *Ocean-snail.* Shell thin, snail-shaped; aperture four-sided; pillar twisted; lip thin, notched at the outer angle; violet-blue. Animal with a large head and tentacles; no eyes; foot small, secreting a float of numerous air-bladders.

I. communis. Fig. 173; *n. s.*
exigua.
pallida.



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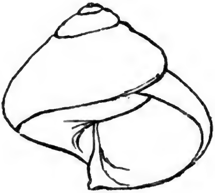


173

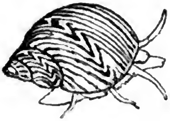
FAMILY VII. TROCHIDÆ.

Shell spiral, snail-shaped, or pyramidal; interior generally pearly. Animal with a short muzzle, eyes, and slender tentacles; head and sides furnished with fringed lobes and filaments; gill-plume single; tongue long, narrow, armed with numerous teeth and hooks. Vegetable feeders.

Phasianella (Lamk.). Shell polished; whorls convex; aperture oval, not pearly; outer lip thin; operculum shelly. Animal with long fringed tentacles; foot rounded in front, its sides moving alternately.

P. pullus. Fig. 174; $\frac{3}{1}$.

174



175

176

Trochus (Linn.). *Top.* Shell pyramidal, nearly flat at the base; aperture oblique, somewhat four-sided; pearly; operculum horny, many-whorled. Animal with two minute head-lobes, large neck-lappets, side-lobes, and filaments.

T. alabastrum.
cinerarius.
conulus.
exiguus.
granulatus.
helicinus.
crassus.
magus.

T. millegranus.
Montagui.
pusillus.
striatus.
tumidus.
umbilicatus.
undulatus.
ziziphinus. Fig. 175; *n. s.*

Adeorbis (Wood). Shell minute, depressed, few-whorled, deeply umbilicated; operculum shelly, many-whorled.

A. sub-carinata. Fig. 176; $\frac{5}{1}$.

FAMILY VIII. LITTORINADÆ.

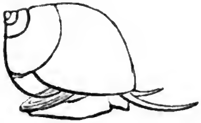
Shell spiral, snail-like, never pearly; aperture rounded; entire; operculum horny, few-whorled. Animal with a thick muzzle, eyes, and tentacles; gill-plume single; tongue long, with a central series of broad, hooked teeth, and three oblong, hooked spines on each side; sides plain; foot grooved at the sides.

Littorina (Férussac). *Winkle.* Shell thick, pointed, few-whorled; outer lip sharp; pillar flattened, not perforated.

L. fabalis.
littoralis.
littorea. Fig. 177; *n. s.*
neritoides.
tenebrosa.

L. palliata.
patula.
rudis.
saxatilis.

177



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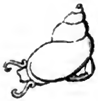

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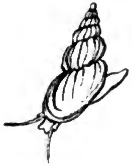


180

181

182

Lacuna (Turton). Shell thin; aperture crescent-shaped; an umbilical fissure.

L. crassior.
pallidula.

L. puteolus.
vincta. Fig. 178; *n. s.*

Rissoa (Frémenville). Shell minute, conical, pointed, lengthened, many-whorled; aperture rounded; outer lip expanded and slightly thickened. Animal with long slender tentacles; foot pointed behind; operculum spiral.

R. abyssicola.
anatina.
Beanii.
calathus.
cingillus.
costata.
costulata.
crenulata.
disjunctus.
fulgida.
inconspicua.
interrupta.
labiosa.
lactea.
littorea.
R. parva. Fig. 179; $\frac{4}{1}$.
proxima.
pulcherrima.
punctura.
rubra.
rufilabris.
sculpta.
semistriata.
soluta.
striata.
striatula.
ulvæ.
ventrosa.
vitrea.
Zetlandica.

Jeffreysia (Alder). As *Rissoa*, but more transparent; operculum semicircular, plaited, with a projection from the straight edge.

J. diaphana.
globularis.
opalina. Fig. 180; $\frac{7}{1}$.

Skenea (Fleming). Shell minute, round, flat, few-whorled. Animal like *Rissoa*, but the foot rounded behind.

S. costulata.
Cutleriana.
divisa.
lævis.
S. nitidissima.
planorbis. Fig. 181; $\frac{5}{1}$.
rota.

Truncatella (Risso). Shell minute, cylindrical, truncated; whorls striated transversely; aperture oval, entire. Animal with short, triangular tentacles; foot rounded at each end.

T. Montagui. Fig. 182; *n. s.*

FAMILY IX. TURRITELLADÆ.

Shell spiral (sometimes tubular), lengthened; upper part partitioned off; aperture simple; operculum horny, many-whorled. Animal with a short muzzle, eyes, and tentacles; mantle fringed; foot very short; gill-plume single.

Scalaria (Lamk.). *Wentletrap.* Shell white, polished, many-whorled; whorls rounded, separated, ornamented with transverse ridges; aperture round.

S. clathratula.
communis. Fig. 183; *n. s.*
Grœnlandica.
S. Trevelyana.
Turtonis.

Cæcum (Fleming). Shell tubular, cylindrical, curved; aperture round; summit closed by a plate; operculum horny, many-whorled.

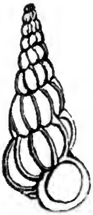
C. trachea.
glabrum. Fig. 184; $\frac{5}{1}$.

Aclis (Lovén). Shell minute, lengthened, spiral; aperture oval; lip prominent. Animal with a long retractile proboscis; tentacles close together; foot truncated in front.

A. ascaris. Fig. 185; $\frac{4}{1}$.
nitidissima.
supranitida.
unica.

Turritella (Lamk.). Shell lengthened, many-whorled, spirally ridged; aperture rounded; lip thin; operculum horny, many-whorled, fringed.

T. communis. Fig. 186; *n. s.*



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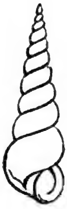

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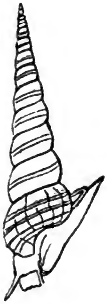


186

Family X. Cerithiadæ.

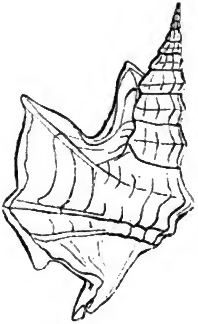
Shell spiral, lengthened, many-whorled; aperture channelled in front, and indistinctly behind; lip generally expanded; operculum horny, generally spiral. Animal with a short muzzle; tentacles distant, slender; eyes on short stalks; mantle with a rudimentary siphon or fold.

Aporrhais (Aldrov.). Shell lengthened, pointed; whorls knobbed; aperture narrow; outer lip becoming expanded and fingered with age; operculum plaited, pointed.

A. pes-pelicani. Fig. 187; *n. s.*
pes-carbonis.

Cerithium (Brug.). Shell very long, tapering, pointed; aperture small, with a tortuous canal; outer lip expanded; inner lip thickened; operculum spiral, few-whorled.

C. adversum.
reticulatum. Fig. 188; $\frac{3}{1}$.
metula.



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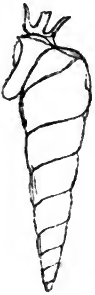


188

Cerithiopsis (Forbes). Shell as *Cerithium;* operculum pointed.

C. tubercularis. Fig. 189; $\frac{3}{1}$.

FAMILY XI. PYRAMIDELLADÆ.

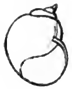
Shell spiral, generally lengthened, pointed; aperture small; pillar often plaited; operculum formed of overlapping plates; animal with broad, ear-like tentacles, and eyes behind them; proboscis retractile; foot truncated in front; tongue unarmed.

Stylina (Fleming). Shell glossy, globose, with a suddenly tapered, slender summit. Lives attached to the spines of Sea-Urchins.

S. Turtoni. Fig. 190 ; $\frac{4}{1}$.

Eulima (Risso). Shell small, white, polished, slender, many-whorled, "obscurely marked on one side by a series of periodic mouths, which form prominent ribs internally ;" aperture oval, pointed above ; outer lip thickened ; inner lip turned back upon the pillar. Animal with slender tentacles.

E. bilineata.
distorta.
polita. Fig. 191 ; *n. s.*
subulata.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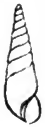
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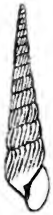
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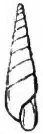
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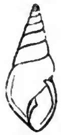

194

Chemnitzia (D'Orb.). Nearly as *Eulima*, but with the whorls plaited ; without orifices ; aperture simple. Animal with triangular tentacles.

C. Barleei.
clathrata.
elegantissima. Fig. 192 ; $\frac{3}{1}$.
fenestrata.
formosa.

C. fulvocincta.
indistincta.
rufa.
rufescens.
scalaris.

Eulimella (Forbes). As *Chemnitzia*, but the shell smooth and polished; pillar simple.

E. acicula. Fig. 193; $\frac{5}{1}$.
affinis.
clavula.
Scillæ.

Odostomia (Flem.). Shell minute, ovate, or tapering, smooth; aperture ovate; pillar with a single fold; lip thin; operculum indented. Animal like *Chemnitzia*.

O. acuta.
alba.
conoidea. Fig. 194; $\frac{4}{1}$.
conspicua.
cylindrica.
decussata.
dolioformis.
dubia.
eulimoides.
excavata.
glabrata.
Gulsonæ.
O. insculpta.
interstincta.
nitida.
obliqua.
pallida.
plicata.
rissoides.
spiralis.
striolata.
truncatula.
unidentata.
Warrenii.

FAMILY XII. NATICADÆ.

Shell globose, few-whorled; spire small, obtuse; aperture very large, semicircular; lip sharp. Animal with a long retractile proboscis; foot very large; mantle with large side-lobes, turned up so as to conceal, more or less perfectly, the shell.

Velutina (Flem.). Shell thin, with a velvety epidermis; no operculum. Animal with a broad head; tentacles blunt, far apart; gills two.

V. flexilis.
lævigata. Fig. 195; *n. s.*

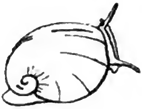
Otina (Gray). Shell minute, ear-shaped. Animal with the mantle simple, and short tentacles.

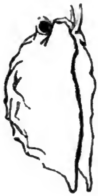
O. otis. Fig. 196; $\frac{4}{1}$.

Lamellaria (Montagu). Shell thin, pellucid; aperture very wide; no operculum. Animal with a very large mantle, quite concealing the shell, notched in front.

L. perspicua. Fig. 197; *n. s.*
tentaculata.

195





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Natica (Lamk.). Shell thick, solid, polished; umbilicus large; operculum sub-spiral. Animal without eyes; a large veil, uniting the tentacles; foot very large, with a fold in front, turned back over the head, and a great lobe behind, partly covering the shell; tongue short; gill single.

N. helicoides.
Kingii.
monilifera. Fig. 198; $\frac{2}{3}$ *n. s.*
Montagui.

N. nitida.
pusilla.
sordida.

TRIBE II. SIPHONOSTOMATA.

Shell spiral; aperture notched or produced into a canal in front; operculum horny, plaited. Animal furnished with a retractile proboscis; eye-stalks united to the tentacles; margin of the mantle produced into a breathing-siphon; gills comb-like, placed obliquely across the back.

Spire concealed	*Cypræadæ.*
Spire manifest:	
Outer lip notched behind . .	*Conidæ.*
Outer lip entire behind:	
Lip notched in front . .	*Buccinidæ.*
Lip produced into a canal .	*Muricidæ.*

FAMILY I. CYPRÆADÆ.

Shell rolled as a scroll, covered with a porcelain-like enamel; spire concealed; aperture narrow, long, channelled before and behind; outer lip (in adult age) thickened, and turned in. Animal with a broad foot; mantle with wide side-lobes, which turn up over the shell.

Cypræa (Linn.). *Cowry.* Shell swollen; outer and inner lip wrinkled transversely.

C. Europæa. Fig. 200; *n. s.*
moneta.*

Ovulum (Lamk.). *Poached Egg.* Inner lip smooth.

O. acuminatum.
patulum. Fig. 199; *n. s.*

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* Taken alive in Cornwall by Mr. Peach. (See *Rep. Brit. Assoc.;* 1844.)

Marginella (Lamk.). Outer lip smooth; inner lip obliquely plaited.

M. lævis. Fig. 201; *n. s.*

201

199

200

202

Family II. Conidæ.

Shell with the body conical, often longer than the spire; aperture usually long and narrow; outer lip notched near its hinder end; operculum minute or wanting. Animal with an oblong foot, truncated in front, with a conspicuous pore in the centre; head lengthened, tentacles remote, carrying the eyes.

Pleurotoma (Lamk.). Shell spindle-shaped; spire lengthened; canal short (in the British species); outer lip with a deep slit at its hinder part.

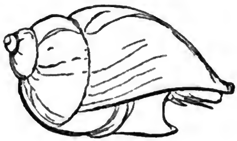
P. attenuata.
brachystoma.
costata.
gracilis.
Leufroyi,
linearis.
nana.
nebula.

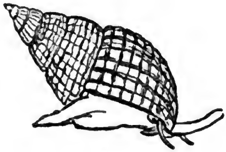
P. purpurea.
rufa. Fig. 202; *n. s.*
septangularis.
striolata.
teres.
Trevelyana.
turricula.
minima.

Family III. Buccinidæ.

Shell swollen, notched in front; hinder part of the lip entire. Animal with a broad foot; eyes seated on the tentacles, without stalks; tongue long, narrow; central teeth single, comb-like; lateral hooks single, notched.

203





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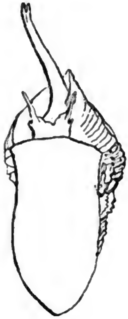


205

Purpura (Lamk.). *Purple*, or *Dog-winkle.* Shell thick; spire short; aperture large, slightly notched; inner lip flattened; operculum plaited.

P. lapillus. Fig. 203 ; *n. s.*

Nassa (Lamk.). *Dog-whelk.* Shell solid, few-whorled; spire rather long; whorls swelling; inner lip expanded, forming a projecting tooth near the canal. Animal with the foot cleft behind, and forming two diverging horns in front.

N. reticulata. Fig. 204 ; *n. s.*
incrassata.
pygmæa.

Buccinum (Linn.). *Whelk.* Shell few-whorled, swelling; spire moderate; aperture large; canal short, turned outwards; operculum plaited. Animal with a broad foot, obtusely pointed behind.

B. undatum. Fig. 205; ⅓ *n. s.*
Dalei.
Humphreysianum.
fusiforme.

206

207

208

FAMILY IV. MURICIDÆ.

Shell spiral; outer lip entire behind; front prolonged into a straight canal. Animal with a broad foot; eyes seated on the tentacles, without stalks; tongue as in the last Family.

Fusus (Lamk.). *Spindle-shell.* Shell spindle-shaped; spire many-whorled; canal long; operculum ovate, curved.

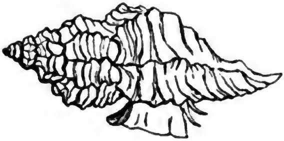
F. antiquus.
Berniciensis.
Islandicus. Fig. 206; ½ *n. s.*
F. Norvegicus.
propinquus.
Turtoni.

Trophon (Montfort). As *Fusus*, but the canal short and oblique.

T. Barvicensis.
clathratus. Fig. 207; *n. s.*
muricatus.

Trichotropis (Broderip). Shell thin, spirally furrowed, umbilicated; pillar obliquely truncated.

T. acuminata.
borealis. Fig. 208; *n. s.*



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Murex (Linn.). *Rock-shell.* Shell roughened with periodical expansions of its lip (*varices*), which are permanent after the lip has advanced; canal partly closed.

M. erinaceus. Fig. 209; *n. s.*
corallinus.

CLASS VII. CEPHALOPODA.

(CUTTLES.)

THE Cuttles and Squids, of which we have but a few species on our shores, are MOLLUSCA, which make the nearest approach of all Invertebrate animals to the Vertebrate forms. Their most characteristic peculiarity is, that the front of the body, which forms a large, well-marked head, carries numerous fleshy *arms*, which are effective instruments for the seizing and holding of the living prey on which the animals feed, and are also used for the purpose of crawling.

Each arm is furnished along its inner side with a single or double series of *sucking-cups*, each of which, on being affixed by the animal to any surface, adheres with a force so great, that it is easier to tear apart the limb than to cause the sucker to let go its hold. The *suckers* are short cylindrical or conical warts, with a central hollow, filled by a moveable fleshy piston, which can be withdrawn at the animal's pleasure, forming a vacuum, when the edges of the cavity, pressed by the whole weight of the overlying water, and with that of the atmosphere above it, adhere to the body of the victim, with a force dependent on the muscular power employed to retract the piston.

In one Family there is, in addition to the ordinary *arms*, a pair of long and slender *tentacles*, which are dilated at their extremities, where they carry groups of suckers, similar to those of the arms.

In the midst of the area surrounded by the bases of the arms is placed the *mouth*, furnished with two horny *jaws*, fitting the one into the other, and closely resembling, in form and action, the hooked beak of a parrot, except that the upper mandible works in the lower. The lower jaw contains a fleshy *tongue*, the structure of which indicates a high development of the sense of taste.

The *intestine*, after making one or two turns, proceeds forwards to the under side of the neck, where it terminates in a projecting tube, called the *funnel*.

All the senses appear to be present in these creatures in a high degree. That of *taste* has been already noticed. The *eyes* consist of a single pair on the side of the head; they are of large size, very brilliant, and in many respects resemble those of the VERTEBRATA, but yet presenting some peculiarities of great interest to the anatomist.

The *ears* are two round cavities in the sides of the head, behind the eyes, in each of which is suspended a membranous sac containing a clear fluid, and a single *otolithe* (ear-stone), composed of carbonate of lime.

A pair of organs, which appear to subserve the sense of *smell*, are also found close beneath or behind the eyes. Each is a minute cavity with swollen borders, containing a soft, wart-like prominence (*papilla*), supplied with special nerves.

The sense of *touch* resides in the whole sensitive and naked *skin*, in the *lips*, and especially in the *arms* and *tentacles*.

In animals so highly endowed we may naturally expect a correspondent development of the nervous system. Here for the first time we see a distinct *brain*, enclosed in a box or chamber of cartilage, answering to the *skull* of the Vertebrate animals. From this centre nerves pass to the organs of sense, to the arms, the mantle, and the various internal organs.

Besides the rudimentary skull, there are found other pieces of cartilage in different parts of the body, as among the muscles at the base of the *funnel*, and (in the Squids) two narrow plates for the support of the side-fins. Thus we have the first approach to the internal bony *skeleton*, which is so characteristic of the VERTEBRATA.

Many species, however, possess also a calcareous *shell*. In the Nautilus and the Argonaut, this is external and ample: but in our native species which possess one, the shell is internal, being enclosed within the substance of the mantle, falling out when the latter is slit open. In the Squids, its form is that of a clear, flexible, horny pen or feather; but in the Cuttle it is an oval, shelly plate, carrying on one of its surfaces a multitude of very thin plates, arranged in layers, kept apart by microscopically minute pillars. Thus, though formed of stony substance, it is so light as to float in water, imparting buoyancy to the animal.

The form of the body in general is more or less that of an oval sac (the *mantle*), from which the head, with its staring eyes and its array of arms, protrudes in front, as does also the funnel; while its sides are in some species dilated into broad swimming-fins.

One of the most curious circumstances in the economy of the Cuttles, is the constantly changing play of various colours which is observed on their surface. During life there are seen coloured spots, which are continually altering their position, size, and figure, running into one another, and separating, playing to and fro, contracting, and dilating, appearing and disappearing with great rapidity, in the most unaccountable manner. These phenomena depend on the structure of the skin, which contains elastic cavities filled with variously coloured fluids, under the influence of the nervous system, and therefore subject to the ever-varying emotions of the animal.

At certain times, as when alarmed, these creatures suddenly discharge from the funnel a volume of fluid, of intense blackness, which is secreted in the ink-bag, a sac lying along the inferior part of the body, and opening at the bottom of the funnel. This fluid was used by the ancients for writing, and by the moderns in the preparation of Indian-ink and sepia.

The circulation does not differ importantly from that of the GASTROPODA. So far as is known, there is no system of completely closed blood-vessels. The blood is sometimes green or violet, but sometimes colourless. Breathing is performed by means of gills situated in the cavity of the mantle. These organs are long pyramids, formed of a central stem, beset with numerous transverse plates or arches. It is a singular circumstance that the gills are not ciliated; the water which bathes them enters the cavity beneath the borders of the mantle, and is discharged periodically through the funnel.

The sexes are always distinct. In many species the males are unknown; in others, they resemble the females; but in others, they present the most extraordinary peculiarities. On certain female CEPHALOPODA there have been observed from time to time worm-like creatures, called *Hectocotyli*, which have been supposed to be parasitic worms. They resemble single detached arms of the species, being armed with rows of suckers, and adhere to the interior of the gill-cavity of the female. Dr. Kölliker first suggested that these supposed worms were the males; but, from the researches of H. Müller and others, it appears that the *Hectocotylus* is not an independent animal, but "an arm metamorphosed in a very irregular manner," and detached, in order to play an apparently independent part in impregnating the female.*

The eggs are laid in masses, enclosed in envelopes, by which they are bound together, and often attached to rocks or sea-weeds, or else are united into chaplets which float in the open sea. The young are hatched in the form of the parent, so that they undergo no metamorphosis.

Localities, &c.—All our species are residents of the deep water. Sometimes they may be found in pools at low water, left by the retiring tide, and occasionally specimens are washed up on a sandy beach; but generally they are free swimmers and rovers, often congregating in shoals. Their period of activity is chiefly nocturnal. The little *Sepiola* burrows in sand, which it excavates in a curious manner by blowing repeated gusts of water out of its funnel.† All the species are carnivorous and ferocious, preying on any marine animals which they can master.

Identification.—The number of the arms; the presence of accessory tentacles; the eyes, whether moveable or fixed; the form of the body; the presence or absence of fins at the sides; the presence, texture, and form of the shell; the existence of a web uniting the bases of the arms; the arrangement of the suckers; the comparative length of the arms; the number of the suckers on each arm; the form, size, and hue of the colour spots,—constitute the points to be chiefly attended to in distinguishing the species in this Class.

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* See Siebold's Comp. Anat. § 261. (Burnet's Transl. and note.)

† See my "Aquarium," p. 69.

Authorities.—Siebold's "Comparative Anatomy," with Dr. Burnet's Notes; Woodward's "Manual of the Mollusca;" and Gray's "Catalogue of the Cephalopoda in the British Museum."

CEPHALOPODA.

Molluscous animals without a foot, with a distinct head, crowned with numerous fleshy arms, bearing sucking-disks; enveloped in a sac-like mantle, open in front, and sometimes enclosing in its substance a rudimentary shell (the shell external only in foreign species); having a rudimentary brain, and a rudimentary skeleton of cartilage; breathing by gills, which are bathed by water passing in beneath the mantle, and discharged through a tube.

Order I. DIBRANCHIATA.

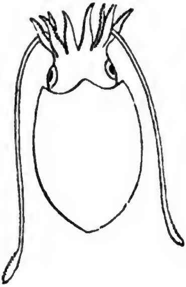
Animal with a naked body, a distinct head, sessile eyes, horny jaws, eight arms; a round or oblong body formed for swimming; two gills, and a shell (when present), either horny or shelly, always (in British species) concealed in the mantle.

With two tentacles; eyes moveable .	*Decapoda.*
Without tentacles; eyes fixed . . .	*Octopoda.*

TRIBE I. DECAPODA.

Arms eight; tentacles two, long, slender, with expanded ends; suckers stalked; eyes moveable in their sockets; body lengthened, with a pair of side-fins; shell loose in the mantle.

Fins long; shell calcareous . . . . . *Sepiadæ.*
Fins short and broad; shell horny . *Teuthidæ.*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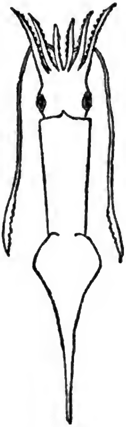
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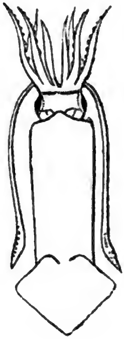

212

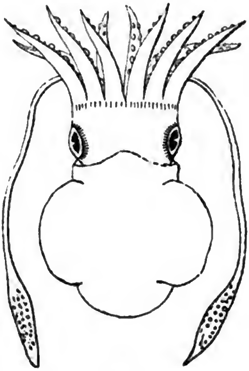
FAMILY I. SEPIADÆ.

Animal with the body broadly ovate; tentacles lengthened, broadly expanded at their tips; side-fins narrow, bordering the whole length of the sides; funnel large and short, closed with an internal valve. Shell ("cuttle-bone") calcareous, flat, composed of a broad plate of stony substance, with a horny edge, and a sharp tip; its concavity filled with layers of spongy substance, supported by pillars.

Sepia (Linn.). *Cuttle-fish.* Arms with four rows of suckers; mantle supported by warts, fitting into sockets on the neck and funnel.

S. officinalis. Fig. 210; $\frac{1}{10}$ *n. s.*
Rupellaria.
biserialis.

213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FAMILY II. TEUTHIDÆ.

Animal with the body lengthened; fins short, broad, mostly at the hinder end; shell a horny, flexible pen.

Loligo (Lamk.). *Squid.* Body smooth, lengthened, taper behind; fins united, rhombic; arms with two oblique rows of suckers; tips of tentacles with four rows; eyes covered with skin. Shell pen-like, with the shaft produced in front.

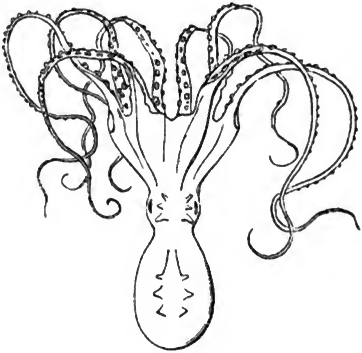
L. vulgaris.
media. Fig. 211; $\frac{1}{3}$ *n. s.*
marmoræ.

Ommastrephes (D'Orb.). *Flying Squid.* Nearly as *Loligo*, but the tentacles are short and stout, and the eyes are naked. Pen formed of a three-ribbed shaft, and a hollow conical appendage.

O. sagittatus. Fig. 212 ; $\frac{1}{4}$ *n. s.*
todarus.
Eblanæ.

Sepiola (Leach). Body short, purse-like; mantle supported by a broad neck-band, and a ridge fitting a groove in the funnel; fins rounded, contracted at their base, placed on the sides of the back ; suckers of arms set on long stalks.

S. Rondeletii. Fig. 213 ; *n. s.*
atlantica.



215

Rossia (Owen). Body nearly as *Sepiola ;* no neck-band; mantle supported by a small knob, fitting a groove in the funnel; fins oval, broad at their union with the back ; suckers of arms sessile ; those of tentacles stalked.

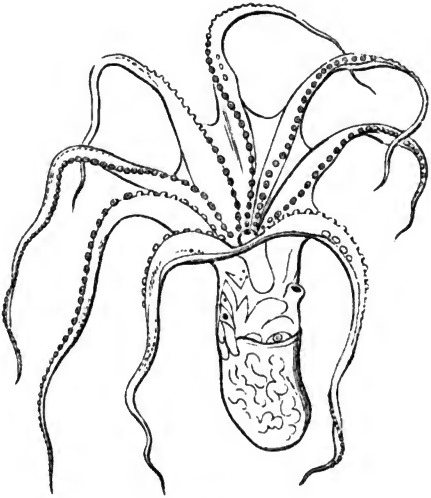
R. Owenii. Fig. 214 ; $\frac{1}{2}$ *n. s.*
macrosoma.

TRIBE II. OCTOPODA.

Arms eight; tentacles none; suckers sessile; eyes fixed, incapable of rotation; body united to the head by a broad neck-band; no lateral fins; shell (in the British species) internal and rudimentary.

Octopus. (Cuv.). *Poulpe.* Body oval, warty, without fins; arms long, unequal, united at the base by a web; suckers in two rows; shell two short styles, enclosed in the mantle.

O. vulgaris. Fig. 215; $\frac{1}{8}$ *n. s.*



216

Eledone (Leach). Body small, oblong; arms long, tapering, webbed; suckers in a single row.

E. octopodia. Fig. 216; $\frac{1}{6}$ *n. s.*

SUB-KINGDOM V. VERTEBRATA.

CLASS I. PISCES.

(FISHES.)

OF that large division of animate beings which are distinguished by an internal skeleton of bone, and of which the most marked character is the possession of a prolongation of the brain (known as the *spinal cord*), enclosed in a series of tubular bones (the *vertebræ*), which unitedly constitute the spine, the Class of Fishes is almost the only one which falls within the province of the British Marine Zoologist. It is the most populous in species of all, and the marine kinds greatly exceed in number (and in importance also) those which inhabit fresh waters.

The *skeleton*, of which a rudimentary sketch, if I may so call it, appears first in the CEPHALOPODA, is, in the lowest forms of the present Class, scarcely advanced in structure. In the *Myxine* and *Amphioxus*, it is a simple tube of cartilage, of which the divisions into joints are only indicated; and it is not until we arrive at the higher Orders that we obtain true bone.

The elements which enter into the *vertebræ*, or joints of the spine, are the same in all Fishes. They are as follows:—1, The *central cylinder;* 2, the *superior arch*, formed by two sloping side pieces, between which the spinal marrow passes;

3, the *superior spinous process*, projecting upward from the union of these pieces; 4, the two *lateral processes;* 5, the *inferior arch*, formed as the superior is, protecting great blood-vessels; 6, the *inferior spinous process*, pointing downward.

The *skull* is considered to be but a number of *vertebræ* excessively altered in form, to serve a special purpose, that of forming a box to enclose the *brain*, cavities to protect the organs of sense, and jaws to seize and masticate the food.

As accessory to the spinal column, we find three sets of bones developed from its sides. 1, The *hyoid arches*, which spring from the skull, and form the firm framework on which the gills are hung; 2, the *ribs*, another numerous series of arches, which protect the internal organs, and serve as the support of muscles; 3, the *limbs*, of which there are two pairs, each limb consisting of several pieces jointed to each other, of which the first is jointed to the spine, while the last is free. In Fishes, the last joint of the limb carries a number of slender spines or rays, united by a thin membrane in most cases, and forming a *fin*, to be used in swimming. It may be considered as a hand of many fingers.

Both pairs of limbs are, in the present Class, suspended from the *vertebræ* that enter into the composition of the skull. The upper pair are termed *pectoral fins*, and correspond to the human arms and hands; the lower pair, termed *ventral fins*, represent the feet. The latter may be before, beneath, or behind the former (but always nearer to the line of the belly), and are sometimes wanting.

In addition to this internal skeleton, Fishes present an extensive external one. The body is in general covered with *scales*, which are pieces of bone developed from the skin, and overlapping each other. But more essential to the Fish are certain series of sword-like bones, which penetrate the flesh along the line of the back, along the line of the belly, and around the extremity of the spine, to which are jointed bony or flexible rays, resembling those of the true limbs, and, like them, united by membrane. These series are important instruments of locomotion, and are designated respectively, the back-fin (*dorsal*), the vent-fin (*anal*), and the tail-fin (*caudal*).

The teeth of Fishes vary exceedingly in form, arrangement, and position. "The most common shape is that of an elongated cone, either straight or curved. When the conical teeth are small and numerous, they are compared to the points of the cards used for carding wool or cotton; and they are sometimes so slender, yet so dense from their numbers, as to resemble the pile of velvet or plush; and often, from their very minute size, their presence is more readily ascertained by the finger than by the eye. Some fishes have in the front of the jaws flat teeth with a cutting edge, like a true incisor; others have them rounded or oval; they are then most frequently planted in rows, and adapted to bruise or crush the various substances with which they are brought in contact."*

Unlike the MAMMALIA, in which the teeth are confined to the jaws, Fishes may have every bone that assists to form the cavity of the mouth and throat furnished with these organs. As they constitute important characters for identification, it may be as well to name the chief positions in which they occur. In some members of the great Salmon family, for instance, we find a row of teeth on the bone that forms the middle ridge of the palate, which is called the *vomer;* on each side of this is another row on the *palatine* bones; and outside these is another pair of rows on the *upper jaw-bones.* In the lower half of the mouth the *tongue* carries a row of teeth along each edge, which, when the mouth is closed, lock in between the *vomerine* and the *palatine* teeth; while the *lower jaw-bones* are also armed, each with a row which locks in between the *palatine* and the *upper jaw* (*maxillary*) *teeth.* In other families we find teeth on the bony *arches of the gills*, on the bones of the throat (*pharynx*), or on the bones called the *inter-maxillaries*, that lie partly before and partly between the upper jaws.

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* Yarrell's "British Fishes," i. 113.

Fishes have cold blood; that is to say, the blood does not, in general, rise appreciably above the temperature of the element in which they swim. It is invariably red. The heart consists of one *auricle* and one *ventricle*, which receive the blood from the veins, and send it to the gills for renewal by the absorption of oxygen; whence it is circulated through the body in arteries. Both the arteries and the veins are perfectly closed vessels.

The breathing-organs (*gills*) consist ordinarily of many rows of thin membranous plates hung on slender arches of bone. These organs are placed on each side of the head, and are usually protected by a great bony plate (the *gill-cover*), made up of several pieces. The water to be breathed is taken in at the mouth, passes over the gill-membranes, and is ejected through an orifice at the hind margin of the gill-cover.

In many Fishes there is a large bladder situated within the body, between the spine and the bowels. It assumes various forms, and is always filled with air, which, in Marine Fishes, is principally composed of oxygen. It is supposed to be connected with the buoyancy of the animal, and hence is often called the *swimming-bladder;* but there are structural reasons for considering it to be the first rudimentary form of an air-breathing *lung*.

Fishes, like all other VERTEBRATA, have the *sexes* separate. Among the Sharks and Skates, the male may be known by a long cylindrical appendage at the inner edge of each ventral fin, which is entirely wanting in females. In general, however, the females are distinguishable from the males only by the body being deeper and fuller, while the males have the head and gills more developed.

With a few exceptions, more apparent than real, the young are produced from *eggs*, which, being deposited at regular periods, and usually in vast numbers, are commonly called *spawn*. The mass of immature eggs in the body of the female fish is well known under the name of *hard roe*. The roe of a Cod has been computed to contain six millions of eggs.

For the most part, the spawn is committed to the waters with but little precaution for its preservation: sometimes it is twined around a seaweed, sometimes laid like beads within the valves of a dead shell, sometimes dropped into a furrow, ploughed in the bottom-gravel. But a few examples have recently come under the observation of naturalists, in which an elaborate nest is constructed for the reception of the eggs, which are watched with zealous care by the parent fish until they are hatched, and, in some instances, until the young are able to shift for themselves. Among the Pipefishes (*Syngnathidæ*), the male acts as nurse to the infant progeny, receiving the spawn from the mother into a sort of pouch, with which he is provided, and in which he carries the eggs till the birth of his offspring relieves him from his duties.

Localities, &c. — From the roving habits of Fishes, little can be said on this score. Many species, as the Mackerel and Herring tribes, approach the shores from deep water at certain seasons, for the purpose of spawning in the shallows. The Blennies and Gobies are generally to be found in the shallows; the Smooth Blenny, the Sea Scorpion, and some other small species haunt the clear rock-pools, which the receding tide leaves on many of our coasts. The Weevers, the Launces, and many of the Flatfishes, burrow in the sand of the sea-bottom; the Wrasses play around submerged rocks; and the Pipefishes haunt the waving beds of green sea-grass (*Zostera*) that grow on muddy shores. Some, as several species of the Salmon family, the little Sticklebacks, the Eels, and others, inhabit both the sea and rivers indifferently, or periodically exchange the one for the other. Others, as the Bonito, are truly ocean-rovers, and approach our coasts rarely and accidentally.

Identification.—The following points, set down, approximately, in the order of their relative importance, are needful to be observed in determining the zoological place and relations of a Fish.

The texture of the skeleton, whether bone or cartilage; the form of the jaws, whether moveable or soldered together; the gill-orifices, whether several holes in the neck, or a single one opening from beneath a lid; the gills, whether arranged like the teeth of a comb, or in tufts; the rays of the dorsal and anal fins, whether mostly soft and jointed, or mostly hard and spiny; the position of the ventral-fins; the form and toothing of the gill-covers; the form and arrangement of the teeth; the number of the gill-rays; the size, form, and extent of the scales; the number and form of the dorsal-fins or fin; the form of the caudal-fin; the presence of spines; the general shape of the body; the freedom of movement in the jaws; and the number of rays in the different fins.

Authorities. — The arrangement proposed by Cuvier, and modified by the Prince of Canino, has been mainly followed; while, for the appropriation of species to our seas, no higher authority need be sought, or can be found, than Mr. Yarrell's admirable "History of British Fishes."

PISCES.

Vertebrate animals, having cold blood; breathing by means of permanent gills; inhabiting water; furnished with fins for locomotion; producing eggs.

Skeleton composed of cartilage . .	*Cartilaginei.*
Skeleton composed of bone . . .	*Ossei.*

SUB-CLASS I. CARTILAGINEI.

Skeleton cartilaginous, without bony fibres; skull formed of a single piece.

With fixed gills:	
Mouth forming a sucker	*Cyclostomata.*
Mouth armed with jaws . . .	*Selachia.*
With free gills	*Sturiona.*

Order I. CYCLOSTOMATA.

Skeleton rudimentary; spine an unjointed column of cartilage; no ribs; no pectoral or ventral fins; mouth a sucking-disk, surrounded by a ring of cartilage.

217

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Amphioxus (Yarrell). *Lancelet.* Compressed, doubly pointed; mouth a long slit, with a row of filaments on each side; a dorsal fin along the whole length of the back.

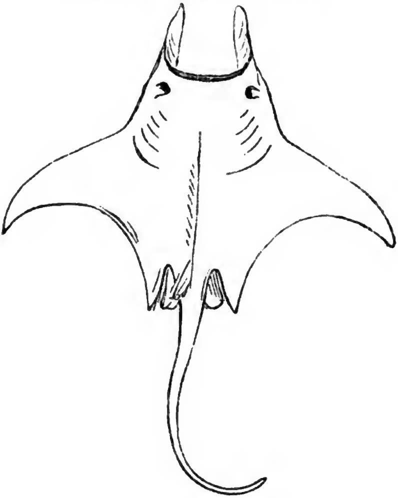
A. lanceolatus. Fig. 217; $\frac{1}{2}$ *n. s.*

Myxine (Linn.). *Hag.* Cylindrical; an orifice (*spiracle*) on the head; mouth round, surrounded by eight filaments, and armed with one tooth; dorsal along the back, continued round the tail to the vent.

M. glutinosa. Fig. 218; $\frac{1}{3}$ *n.s.*

Petromyzon (Linn.). *Lamprey.* Cylindrical; gill-openings seven on each side of the neck; mouth round, armed with many teeth; dorsal as in *Myxine.*

P. marinus. Fig. 219; $\frac{1}{8}$ *n.s.*



220

Order II. SELACHIA.

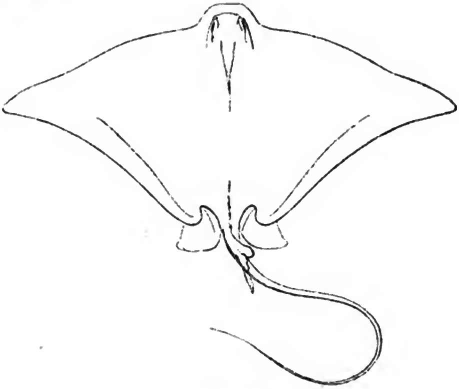
Skeleton complete; jaws (formed of the *palatal* and *post-mandibular* bones) armed with teeth;

pectoral and ventral-fins present; gills attached at their outer edge, with separate orifices to each gill.

Body flat, with a slender tail; pectorals enormous, meeting in front . . .	*Raiadæ.*
Body long, tapering gradually; pectorals moderate	*Squalidæ.*

FAMILY I. RAIADÆ.

Body forming with the large fleshy pectorals a broad flat disk; pectorals generally united before the snout; eyes and orifices (*spiracles*) above; mouth, nostrils, and gill-orifices below; dorsals on the tail.



221

Cephaloptera (Risso). *Horned Ray.* Head truncate, with a membrane rolled on itself, on each side; eyes large, lateral; otherwise resembling *Trygon.*

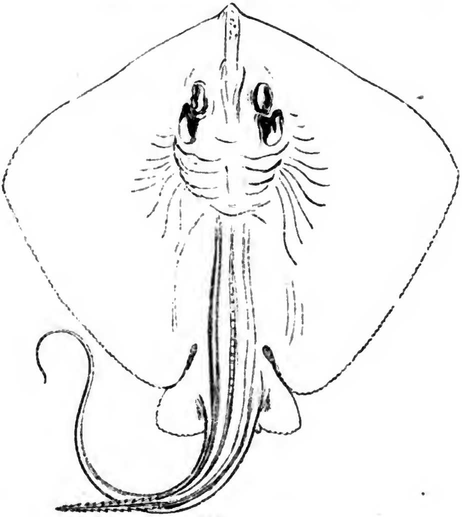
C. Giorna. Fig. 220; $\frac{1}{100}$ *n.s.*

Myliobatis (Cuv.). *Eagle Ray.* Head projecting; pectorals extended like wings; teeth pavementlike; tail armed with one dorsal-fin, and a notched spine.

M. aquila. Fig. 221; $\frac{1}{8}$ *n. s.*

Trygon (Cuv.). *Fireflaire.* Head enclosed by the pectorals; tail with a doubly-notched stiff spine, without a dorsal.

T. pastinaca. Fig. 222; $\frac{1}{6}$ *n. s.*



222

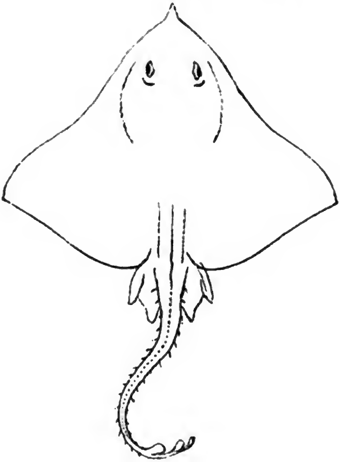
Raia (Linn.). *Skate.* Body rhomboidal; tail with no spine, but with two small dorsals near the tip.

R. radiata.
clavata.
fullonica.
spinosa.
miraletus.
microcellata.

R. marginata. Fig. 223; $\frac{1}{6}$ *n. s.*
batis.
intermedia.
oxyrhynchus.
mucronata.

Torpedo (Cuv.). *Cramp-fish.* Body nearly round; tail short, fleshy, with two dorsals, and a caudal; teeth small and sharp.

T. nobiliana.
marmorata. Fig. 224 ; $\frac{1}{8}$ *n. s.*



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Family II. Squalidæ.

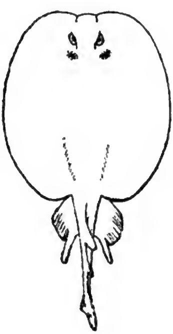
Body lengthened, merging insensibly into a thick tail; pectorals of moderate size; gill-orifices on the sides of the neck; eyes lateral.

Squatina (Dumeril). *Angel.* Depressed; head rounded in front; spiracles large; pectorals very large; two dorsals and a caudal on the tail; no anal.

S. angelus. Fig. 225 ; $\frac{1}{10}$ *n. s.*

Echinorhinus (Blainv.). *Spinous Shark.* First dorsal opposite the ventrals; teeth in both jaws, broad and low, the edge nearly horizontal, their sides with one or two transverse toothlets; skin studded with spines.

E. spinosus. Fig. 226; $\frac{1}{30}$ *n. s.*



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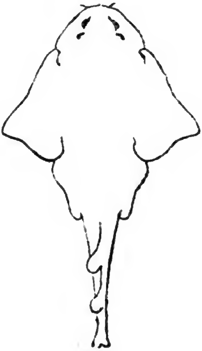

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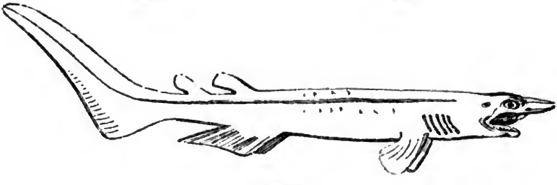


226

227

Scymnus (Flem.). All the fins small; two dorsals, one before, the other behind the ventrals;

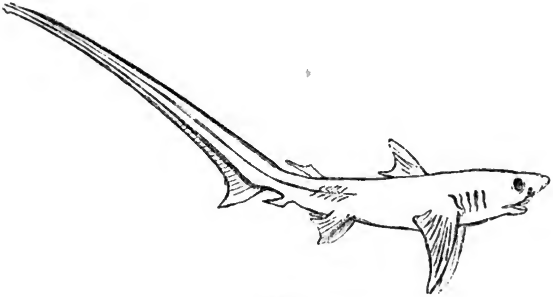
no anal; spiracles large; teeth lancet-shaped, diverging from the centre; skin rough.

S. borealis. Fig. 227; $\frac{1}{50}$ *n. s.*

Acanthias (Risso). *Picked Dog-fish.* Two dorsals, each preceded by a spine; no anal; skin rough, with heart-shaped scales, each with a central spine; several rows of teeth in each jaw.

A. vulgaris. Fig. 228; $\frac{1}{6}$ *n. s.*

228



229

Alopias (Bonaparte). *Sea-fox.* Two dorsals, the first high, the second over the anal; head pointed; upper portion of the tail very long, notched at the base.

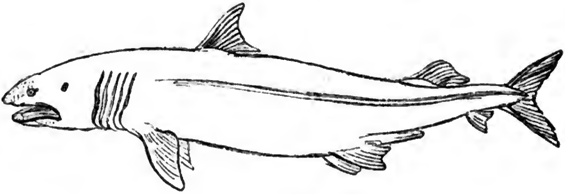
A. vulpes. Fig. 229; $\frac{1}{50}$ *n. s.*

Selachus (Cuv.). *Basking Shark.* Two dorsals, wide apart; snout short and blunt; gill-openings very large.

S. maximus. Fig. 230; $\frac{1}{120}$ *n. s.*

Lamna (Cuv.). *Porbeagle.* Two dorsals, as in *Alopias ;* snout pointed; both portions of the tail large, nearly equal; gill-openings large.

L. Cornubica. Fig. 231; $\frac{1}{12}$ *n. s.*



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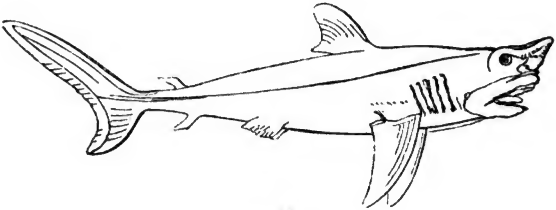


231

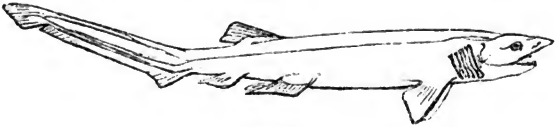
232

Galeus (Cuv.). *Tope.* Two dorsals, the first behind the pectorals, the second over the anal; head flat and long; teeth pointed, concave, and serrated on the outer edge.

G. vulgaris. Fig. 232; $\frac{1}{24}$ *n. s.*

Notidanus (Cuv.). One dorsal, over the anal; teeth of the upper jaw triangular, of the lower jaw saw-like; six gill-openings.

N. griseus. Fig. 233; $\frac{1}{20}$ *n. s.*



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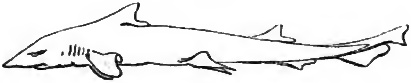

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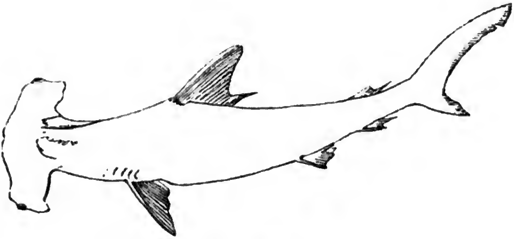


235

Mustelus (Cuv.). *Smooth Hound.* As *Galeus*, but the teeth are flat, as in the *Raiadæ*.

M. lævis. Fig. 234; $\frac{1}{8}$ *n. s.*

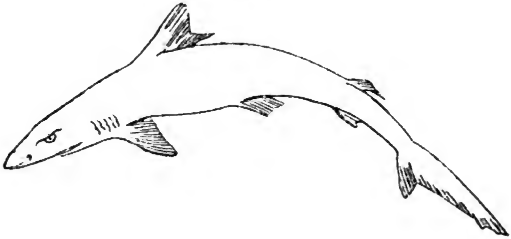
Zygæna (Risso). *Hammer-head.* Head flat, produced on each side, with the eyes at the extremities; fins as in *Galeus*.

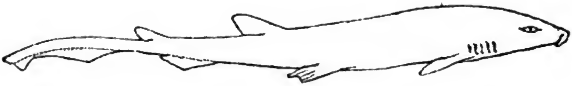
Z. malleus. Fig. 235; $\frac{1}{50}$ *n. s.*

Carcharias (Cuv.). *Shark.* Head pointed, flattened; teeth flat, pointed, cutting, notched at the edges; no spiracles.

C. vulgaris. Fig. 236 ; $\frac{1}{80}$ *n. s.*
glaucus.

236





237

Scyllium (Cuv.). *Dog-fish.* Head blunt; nostrils near the mouth, continued in a groove to the lip; spiracles distinct; teeth with a long point, and a shorter one on each side; two dorsals, both behind the middle.

S. canicula. Fig. 237 ; $\frac{1}{6}$ *n. s.*
catulus.
melanostomum.

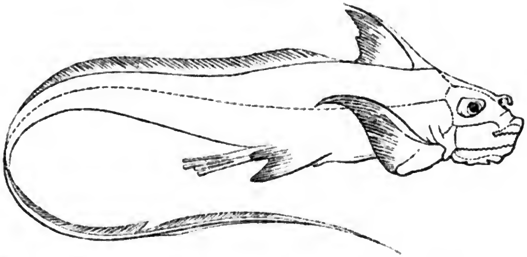
Order III. STURIONA.

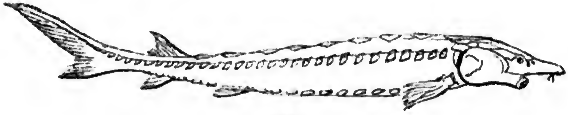
Gills free, as in the Bony Fishes, protected by a gill-cover, and opening by a single wide orifice, on each side.

Chimæra (Linn.). Gill-cover rudimentary; gills partly attached; tail ending in a long filament; two dorsals, the first high and short, the second low and long; skin smooth.

C. monstrosa. Fig. 238; $\frac{1}{6}$ *n. s.*

238





239

Acipenser (Linn.). *Sturgeon.* Body angular, the angles carrying bony plates; snout pointed, furnished with filaments; mouth tubular, without teeth; gill-cover broad, bony; tail two-lobed, unequal.

A. sturio.
latirostris. Fig. 239; $\frac{1}{25}$ *n. s.*

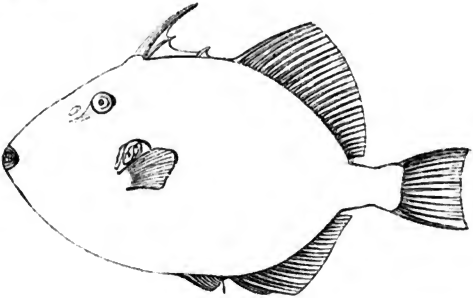
SUB-CLASS II. OSSEI.

Skeleton formed of bone; skull composed of many distinct pieces.

Jaw-bones soldered together . .	*Plectognathi.*
Jaw-bones free:	
Gills arranged in tufts	*Lophobranchii.*
Gills in comb-like fringes:	
Fin-rays soft, jointed	*Malacopterygii.*
Fin-rays (partly) spinous . .	*Acanthopterygii.*

Order I. PLECTOGNATHI.

Skeleton partly of bone, partly of cartilage; jaws formed by the soldering together of the *maxillaries* and *inter-maxillaries;* arch of the palate united to the skull; mouth small, almost motionless; gill-opening small; body usually short and thick.



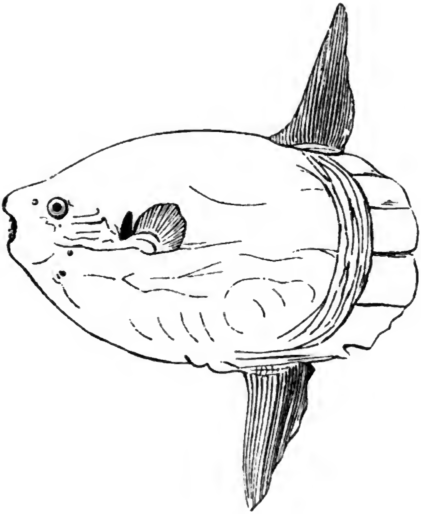
240

Balistes (Linn.). *File-fish.* Body compressed, covered with lozenge plates; first dorsal spinous; cutting-teeth in both jaws.

B. capriscus. Fig. 240; $\frac{1}{4}$ *n. s.*

Orthagoriscus (Schneider). *Sunfish.* Body compressed, deep, short, truncate behind; jaws undivided, forming cutting-edges; dorsal and anal high, pointed; caudal short and high.

O. mola. Fig. 241 ; $\frac{1}{20}$ *n.s.*
oblongus.



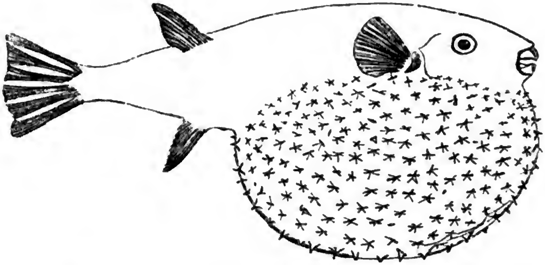
241

Tetraodon (Linn.). *Globe-fish.* Body capable of inflation, partly covered with short spines; jaws divided by a groove, giving an appearance of four teeth.

T. Pennantii. Fig. 242 ; $\frac{1}{8}$ *n.s.*

Order II. LOPHOBRANCHII.

Jaws complete and free; gills disposed in pairs of small round tufts, along the arches; gill-cover large; gill-orifice small; body angular, covered with bony plates.



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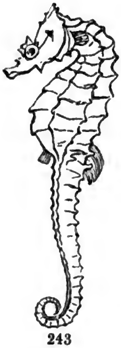


243

Hippocampus (Cuv.). *Sea-horse.* Jaws united into a tube, the mouth at the tip; body compressed, deep, marked by ridges lengthwise and crosswise; pectoral and dorsal in both sexes, anal in the female; no ventrals nor caudal.

H. brevirostris. Fig. 243; ½ *n. s.*

Syngnathus (Linn.). *Pipe-fish.* Body long, slender, tapering, covered with plates set lengthwise; no ventrals; jaws as in *Hippocampus.*

S. acus.
typhle.
æquoreus.

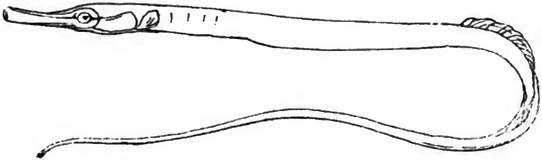
S. ophidion.
anguineus. Fig. 244; ½ *n. s.*
lumbriciformis.

Order III. MALACOPTERYGII.

Jaws free; gills arranged in comb-like fringes; gill-cover large; gill-orifice usually large; fin-rays flexible, jointed, and branched, with the occasional exception of the first two or three rays in the dorsal or pectorals.

Ventrals wanting	*Apoda.*
Ventrals under the pectorals . .	*Sub-brachiati.*
Ventrals behind the pectorals . .	*Abdominales.*

244



245

TRIBE I. APODA.

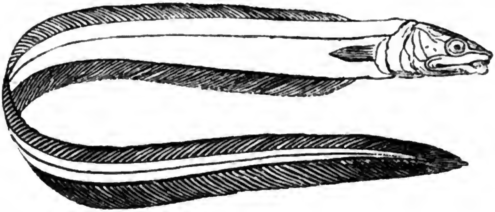
Ventrals wanting; form snake-like.

Ammodytes (Linn.). *Launce.* Gill-orifices large; dorsal nearly the whole length; anal nearly half as long; caudal distinct and separate.

A. Tobianus.
lancea. Fig. 245; ½ *n. s.*

Echiodon (Thompson). Jaws furnished with large cylindrical teeth in front; small teeth on the palate and vomer; body smooth, compressed; gill-orifices large; dorsal and anal nearly as long as the body, united behind, vent close to the head.

E. Drummondii. Fig. 246; ½ *n. s.*



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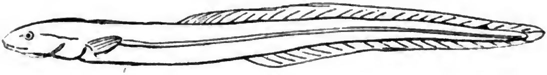


247

248

Ophidium (Linn.). As *Echiodon*, but the jaws armed with small teeth; the anal fin only half the whole length, and the vent near the middle of the body.

O. imberbe. Fig. 247; ½ *n. s.*
barbatum.

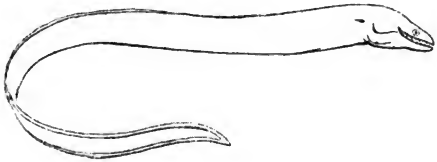
Leptocephalus (Pennant). *Morris.* Head minute; body very thin, translucent; pectorals minute; dorsal and anal as in *Ophidium.*

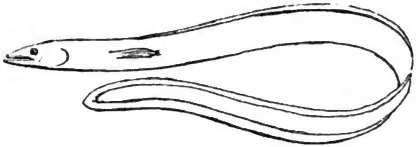
L. Morrisii. Fig. 248; $\frac{1}{2}$ *n. s.*

Muræna (Linn.). No pectorals; dorsal and anal very low, united behind; gill-opening minute; a single row of sharp teeth in each jaw.

M. Helena. Fig. 249; $\frac{1}{12}$ *n. s.*

249





250

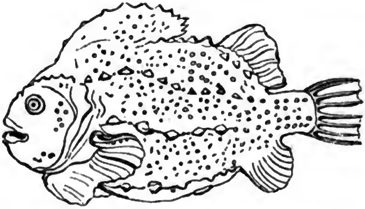
Anguilla (Cuv.). *Eel.* Body cylindrical, long, mucous, with minute imbedded scales; dorsal and anal united behind; teeth in both jaws, and on the vomer.

A. acutirostris. Fig. 250; $\frac{1}{6}$ *n. s.*
latirostris.
conger.

TRIBE II. SUB-BRACHIATI.

Ventrals beneath the pectorals; suspended from the shoulder-bones.

Ventrals united into a sucking disk	*Cyclopteridæ.*
Ventrals separate :	
Head furnished with a sucking disk	*Echeneidæ.*
Eyes on one side of the head; body flat, unsymmetrical	*Pleuronectidæ.*
Form ordinary, symmetrical . .	*Gadidæ.*



251

FAMILY I. CYCLOPTERIDÆ.

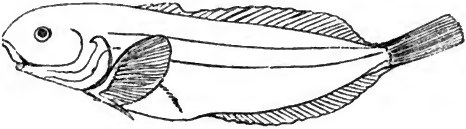
Ventrals and pectorals united to form either one or two circular disks, beneath the body, with the power of adhering to foreign bodies.

Cyclopterus (Linn.). *Lump-fish.* Body deep, with a ridge on the back; two dorsals; first dorsal concealed within the skin; pectorals and ventrals united into a single disk.

C. lumpus. Fig. 251; ½ *n. s.*

Liparis (Flem.). *Sea-snail.* Body lengthened, mucous, without scales; one long dorsal; pectorals and ventrals forming a single disk.

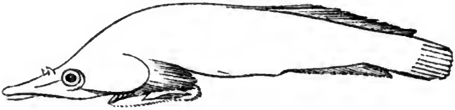
L. vulgaris.
Montagui. Fig. 252; *n. s.*



252

Lepidogaster (Flem.). *Sucker.* Nearly as *Liparis*, but the dorsal is shorter, far behind; pectorals and ventrals forming two disks.

L. Cornubiensis. Fig. 253; *n. s.*
bimaculatus.



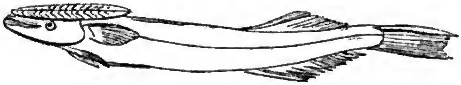
253

FAMILY II. ECHENEIDÆ.

Crown of the head covered with an oblong flat disk, capable of adhering to foreign bodies, and formed of two rows of transverse moveable plates, directed backward; body lengthened; one dorsal placed far behind.

Echeneïs (Linn.). *Remora.* Characters as above.

E. remora. Fig. 254; $\frac{1}{3}$ *n. s.*

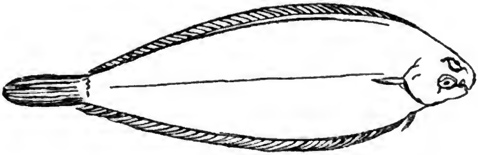


254

Family III. Pleuronectidæ.

(*Flat-fishes.*)

Greatly compressed, always resting on one side, which is destitute of colour; head unsymmetrical; eyes both on the same (the upper and coloured) side; dorsal extending along the whole back; anal nearly as long, on the opposite edge; air-bladder wanting; six gill-rays.



255

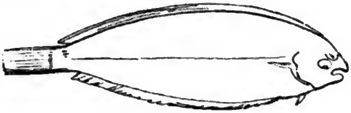
Solea (Cuv.). *Sole.* Eyes on the right side; mouth twisted on the opposite side; teeth in both jaws, but only on the left side; body long-oval.

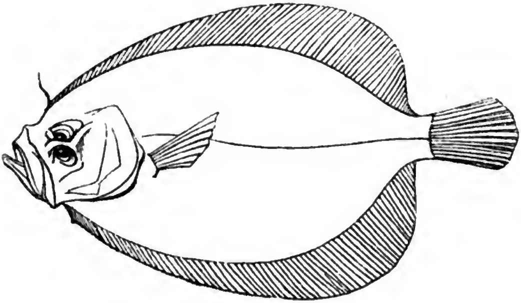
S. vulgaris. Fig. 255; $\frac{1}{4}$ *n. s.*
pegusa.

Monochirus (Cuv.). Pectorals minute, especially the left, which is sometimes wanting; otherwise as *Solea.*

M. lingula. Fig. 256; ½ *n. s.*
linguatula.

256





257

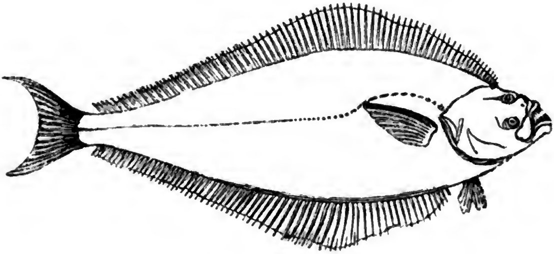
Rhombus (Cuv.). *Turbot.* Eyes on the left teeth in the jaws and throat; dorsal commencing in front of the eyes.

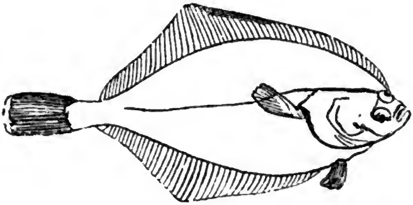
R. maximus.
vulgaris.
hirtus.
punctatus. Fig. 257; *n. s.*
megastoma.
arnaglossus.

Hippoglossus (Cuv.). *Holibut.* Eyes on the right; dorsal and anal commencing behind the head.

H. vulgaris. Fig. 258; $\frac{1}{24}$ *n. s.*

258





259

Platessa (Cuv.). *Plaice, Flounder, Dab.* Eyes on the right; dorsal commencing over the eyes, extending (as also the anal) nearly to the caudal; both fins generally dilated in the middle, giving a rhombic form to the fish.

P. vulgaris.
  flesus. Fig. 259; $\frac{1}{5}$ *n. s.*
  limanda.
  lævis.

P. limandoides.
  pola.
  elongata.

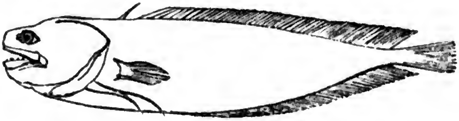
FAMILY IV. GADIDÆ.

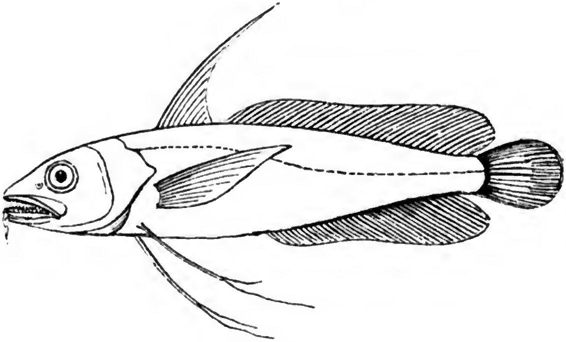
Body long, covered with soft small scales; head naked; fins soft; for the most part two or even three dorsals, and two anals; teeth in rows in the jaws and vomer; seven gill-rays.

Raniceps (Cuv.). *Tadpole-fish.* Head large, flat; body compressed; two dorsals, the first very minute, the second long; ventrals long.

R. trifurcatus. Fig. 260; ¼ *n. s.*

260





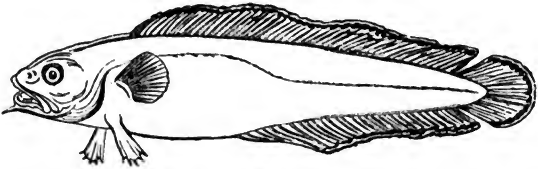
261

Phycis (Cuv.). *Forked-beard.* Body long; two dorsals, the first short, pointed, the second long; a single long, forked ray in each ventral.

P. furcatus. Fig. 261; ⅛ *n.s.*

Brosmius (Cuv.). *Torsk.* A single lengthened dorsal; ventrals fleshy.

B. vulgaris. Fig. 262; $\frac{1}{7}$ *n.s.*



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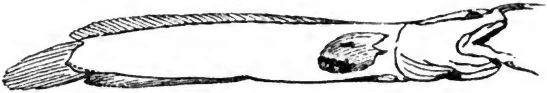

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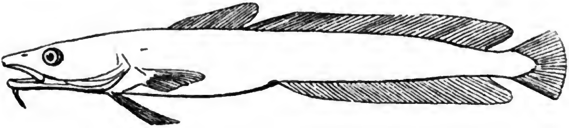


264

Motella (Cuv.). *Rockling.* Two dorsals, the first low, and exceedingly delicate; filaments on the upper as well as the lower jaw.

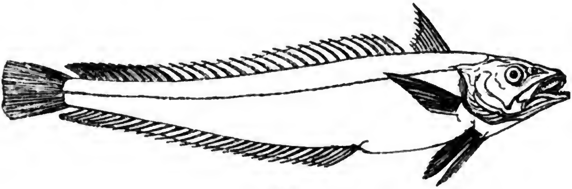
M. vulgaris. Fig. 263; $\frac{1}{4}$ *n.s.*	M. glauca.
cimbria.	argenteola.
quinquicirrata.	

Lota (Cuv.). *Ling.* Body long; two dorsals, both fleshy, and one anal; lower jaw with a filament.

L. molva. Fig. 264; $\frac{1}{16}$ *n.s.*

Merlucius (Cuv.). *Hake.* Body long; head flat; no filament.

M. vulgaris. Fig. 265; $\frac{1}{15}$ *n. s.*



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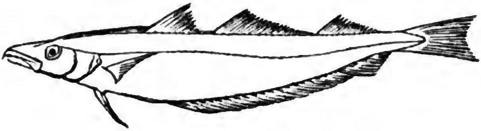

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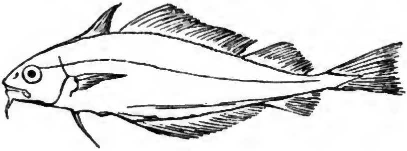


267

Merlangus (Cuv.). *Whiting.* Three dorsals and two anals; no filament.

M. vulgaris. Fig. 266; $\frac{1}{5}$ *n. s.*	M. pollachius.
albus.	virens.
carbonarius.	

Morrhua (Cuv.). *Cod.* Three dorsals and two anals; a filament on the chin.

M. vulgaris.
callarias.
æglefinus.
M. lusca. Fig. 267; ⅕ *n.s.*
minuta.

TRIBE III. ABDOMINALES.

Ventrals behind the pectorals, not attached to the bones of the shoulder, but suspended from the abdomen.

One dorsal, near the middle of the back	*Clupeadæ.*
One dorsal, far behind, opposite to the anal	*Esocidæ.*
Two dorsals	*Salmonidæ.*

FAMILY I. CLUPEADÆ.

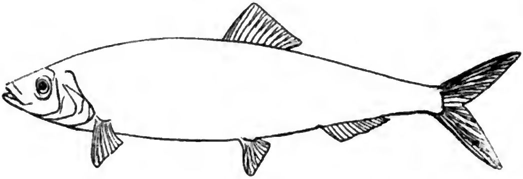
Form graceful; body clothed with large scales, usually forming a saw-like edge along the belly; one dorsal fin, of the ordinary structure, near the middle of the back.

Clupea (Linn.). *Herring, Pilchard.* Body compressed; scales large, thin, easily removed; mouth of moderate size, upper lip entire.

C. harengus. Fig. 268; ¼ *n. s.*
Leachii.
pilchardus.
sprattus.
alba.

Alosa (Cuv.). *Shad.* As *Clupea*, but the upper lip deeply notched.

A. finta. Fig. 269 ; ⅕ *n. s.*
communis.



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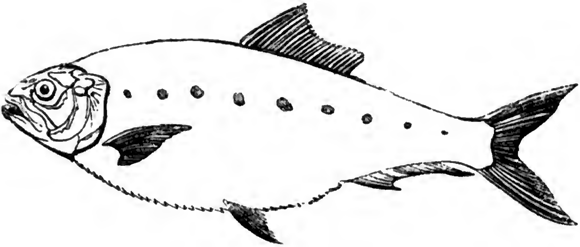

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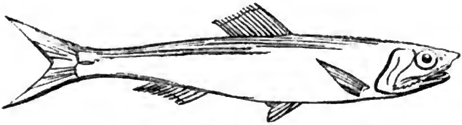


270

Engraulis (Cuv.). *Anchovy.* Head pointed ; mouth very wide ; gill-openings very large ; abdomen smooth.

E. encrasicholus. Fig. 270 ; ½ *n. s.*

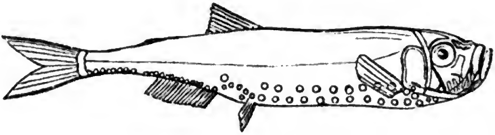
FAMILY II. SALMONIDÆ.

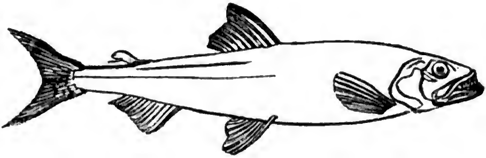
Body graceful, clothed with scales; two dorsals; the first formed of soft rays; the second minute, without rays, formed of skin enclosing fatty substance (*adipose*).

Scopelus (Cuv.). *Argentine.* Body long, slender; second dorsal almost obliterated; mouth wide.

S. Humboldtii. Fig. 271; *n. s.*

271





272

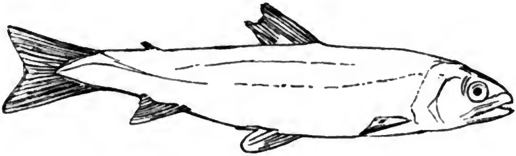
Osmerus (Cuv.). *Smelt.* Characters those of *Salmo*, but the body is more slender; there are two rows of teeth on each palate-bone, but only a few at the very front of the vomer.

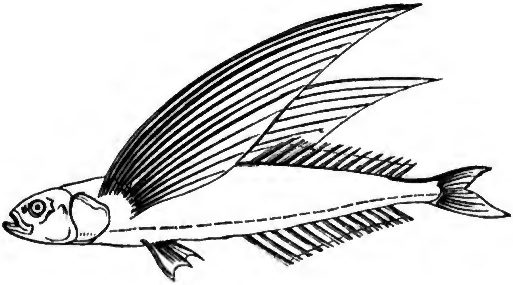
O. eperlanus. Fig. 272; ½ *n. s.*
Hebridicus.

Salmo (Linn.). *Salmon, &c.* Head smooth; body scaled; teeth in the maxillaries, inter-maxillaries, palatals, and mandibularies, and two rows on the vomer, the tongue, and the throat.

S. salar.
eriox.
trutta. Fig. 273; $\frac{1}{6}$ *n. s.*

273





274

FAMILY III. ESOCIDÆ.

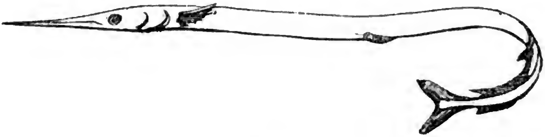
Body generally lengthened, flattened on the back, tapering abruptly; one dorsal, placed far back, and corresponding in form and position to the anal; lower jaw generally projecting.

Exocœtus (Linn.). *Flying-fish.* Head and body scaled; pectorals nearly as long as the body; head flat, somewhat square in outline.

E. volitans.
exiliens. Fig. 274; $\frac{1}{5}$ *n. s.*

Belone (Cuv.). *Garfish.* Body long and slender, covered with minute scales; head smooth; both jaws prolonged into long slender beaks; dorsal and anal entire.

B. vulgaris. Fig. 275; $\frac{1}{7}$ *n. s.*



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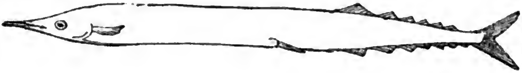


276

277

Scomberesox (Cuv.). *Saury Pike.* As *Belone*, but the dorsal and anal are cut into a number of small triangular finlets.

S. saurus. Fig. 276; $\frac{1}{5}$ *n. s.*

Hemiramphus (Cuv.). *Half-beak.* As *Belone*, but the lower jaw alone is prolonged into a beak.

H. Europæus. Fig. 277 ; *n. s.*

Order IV. ACANTHOPTERYGII.

Jaws free; gills comb-like; gill-covers and orifices generally large; first rays of the dorsal, pectorals, and anal, and generally the first ray of each ventral, unjointed, inflexible, and spinous.

Ventrals behind the pectorals:

- Jaws forming a tube . . . . . *Fistulariadæ.*
- Lips thick, fleshy.
  - One dorsal . . . . *Labridæ.*
  - Two dorsals . . . . *Mugilidæ.*

Ventrals before the pectorals:

- Wrist-joint of pectorals exterior *Lophiadæ.*
- Rays of dorsal flexible . . . . *Gobiadæ.*
- Body thin, ribbon-like . . . . *Cepoladæ.*

Ventrals generally below the pectorals:*

- Rays of dorsal always exposed . *Scombridæ.*
- Rays of dorsal clothed with scales *Chætodontidæ.*
- Spinous rays of dorsal falling into a groove.
  - Gill-covers unarmed . . . . *Sparidæ.*
  - Gill-covers toothed.
    - Head covered with bony plates . . . . *Trigladæ.*
    - Head not plated.
      - No teeth on the palate . *Sciænadæ.*
      - Teeth on the palate . . *Percadæ.*

---

* In *Gasterosteus* they are behind, and in *Cottus* and *Trachinus*, before the pectorals.

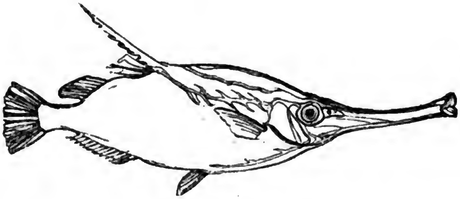
Family I. Fistulariadæ.

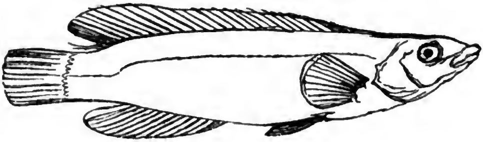
Bones of the head projecting into a long tube, at the tip of which is the small mouth.

Centriscus (Linn.). *Snipe-fish.* Body ovate, compressed; two dorsals.

C. scolopax. Fig. 278; $\frac{1}{2}$ *n. s.*

278





279

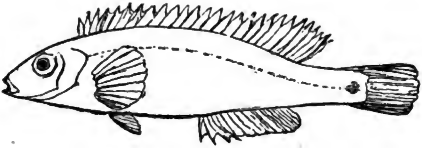
Family II. Labridæ.

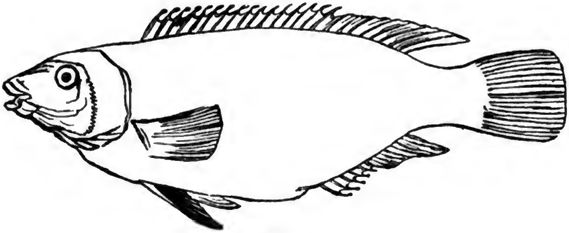
Body oblong, clothed with large scales; one dorsal, frequently with membranous appendages; lips thick and fleshy; teeth large, conical.

Labrus (Linn.). *Wrasse.* Cheeks and gill-covers clothed with scales; gill-covers smooth at the edges; three spines in the anal.

L. maculatus.
  Donovani. Fig. 279; $\frac{1}{3}$ *n. s.*
  mixtus.
  trimaculatus.
  comber.

280





281

Crenilabrus (Cuv.). As *Labrus*, but the gill-covers have toothed edges.

C. melops.
  Norvegicus. Fig. 280; $\frac{2}{3}$ *n. s.*
  pusillus.
  rupestris.

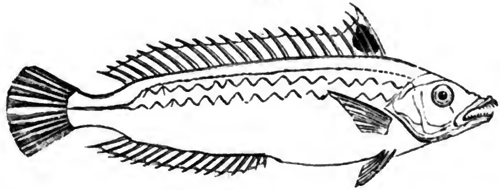
Acantholabrus (Cuv.). Fore gill-cover toothed; six spines in the anal.

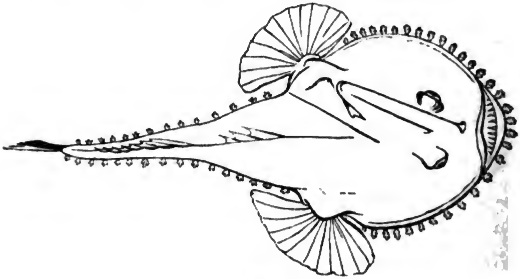
A. Couchii.
  Yarrellii.
  exoletus. Fig. 281; ½ *n. s.*

Julis (Risso). Cheeks and gill-covers without scales; otherwise as *Labrus*.

J. Mediterranea. Fig. 282; ⅓ *n. s.*

282





283

Family III. Lophiadæ.

Body usually grotesque, without scales, irregularly clouded or spotted; head and gape very large, furnished with spines and filaments; wrist-bones of pectorals external to the body, causing these fins to resemble the fore-legs of a quadruped.

Lophius (Linn.). *Frog-fish.* Head enormous, depressed; mouth deeply cleft; jaw fringed with fleshy filaments; two dorsals, with several slender free spines erect on the head; gill-openings under the pectorals.

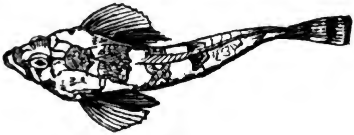
L. piscatorius. Fig. 283; $\frac{1}{16}$ *n. s.*

FAMILY IV. GOBIADÆ.

Body thick, tapering to the tail, secreting a slimy mucus; a single lengthened dorsal or two; the spinous rays unusually slender and flexible; ventrals before the pectorals, composed of two or three rays, or united into a sucking cup, or wanting.

Callionymus (Linn.). *Dragonet.* Head large, flat; eyes on the summit; gill-openings mere holes in the neck; two dorsals; ventrals under the throat, separate, very large; all the fins greatly developed; body without scales.

C. lyra.
dracunculus. Fig. 284; $\frac{1}{3}$ *n. s.*



284

Gobius (Linn.). *Goby.* Ventrals united into a cup-shaped disk; two dorsals; body clothed with large scales.

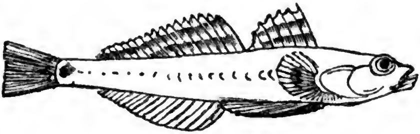
G. niger.
Ruthensparri. Fig. 285; *n. s.*
minutus.

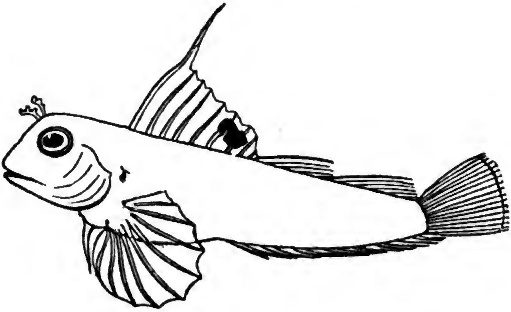
G. gracilis.
unipunctatus.
albus.

Blennius (Linn.). *Blenny.* Head large, blunt, with an abrupt profile; usually armed with fringed appendages; a single lengthened dorsal; ventrals formed of two rays, free.

B. Montagui.
  ocellaris. Fig. 286; $\frac{2}{3}$ *n. s.*
  gattorugine.
  pholis.
  Yarrellii.

285





286

Murænoides (Lacep.). *Gunnel.* Head small; body thin, long, ribbon-like; a low dorsal extending the whole length; ventrals each a very minute spine.

M. guttata. Fig. 287; $\frac{1}{2}$ *n. s.*

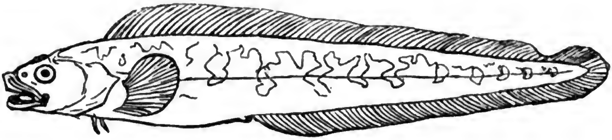
Zoarces (Cuv.). *Eel-pout.* As *Blennius*, but the dorsal and anal are continuous with the caudal.

Z. viviparus. Fig. 288 ; $\frac{1}{3}$ *n. s.*

Anarrhicas (Linn.). *Wolf-fish.* As *Blennius*, but with the ventrals entirely wanting; face round, cat-like; teeth strong and pointed.

A. lupus. Fig. 289 ; $\frac{1}{24}$ *n. s.*

287



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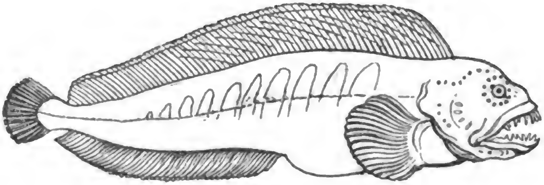


289

FAMILY V. MUGILIDÆ.

Body oblong, more or less cylindrical, clothed with large strongly-marked scales; head depressed, covered with large plates; lips thick; eyes large; two dorsals, short, remote from each other; ventrals behind the pectorals.

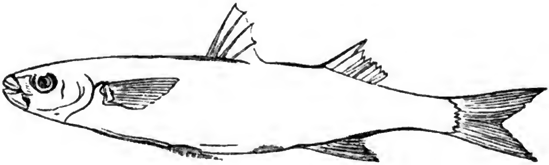
Mugil (Linn.). *Mullet.* Under jaw with a central projection, which is received into a groove in the upper.

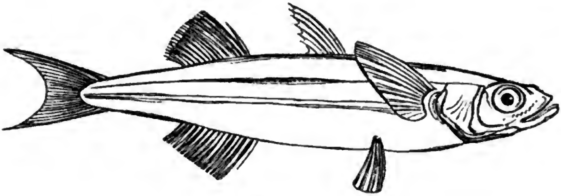
M. capito.
chelo. Fig. 290; ¼ *n. s.*
curtus.

Atherina (Linn.). *Sand Smelt.* Mouth protractile, simple, not thickened; a broad silvery band along each side.

A. presbyter. Fig. 291; ½ *n. s.*

290





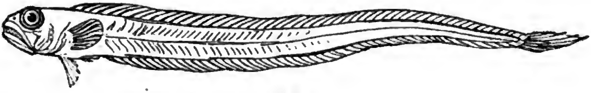
291

FAMILY VI. CEPOLADÆ.

Body long, flattened sidewise, like a ribbon, with minute scales; ventrals usually before the pectorals, sometimes wanting.

Cepola (Linn.). *Band-fish.* Body blade-like, long, gradually decreasing in depth from the head to the tail; mouth oblique; dorsal and anal running nearly the whole length; pectorals, ventrals, and caudal minute.

C. rubescens. Fig. 292; $\frac{1}{4}$ *n. s.*



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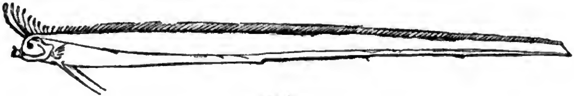

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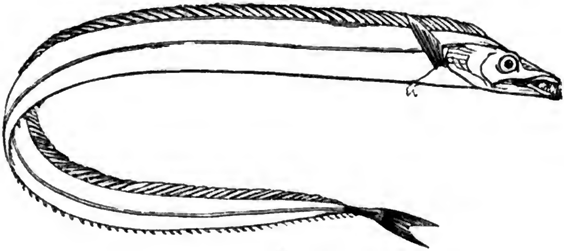


294

Gymnetrus (Bloch). Body thin, long, without an anal; ventrals each of two long slender rays, dilated at the tips; head crowned with tall, slender, erect filaments.

G. Hawkenii.
Banksii. Fig. 293; $\frac{1}{40}$ *n. s.*
glesne.

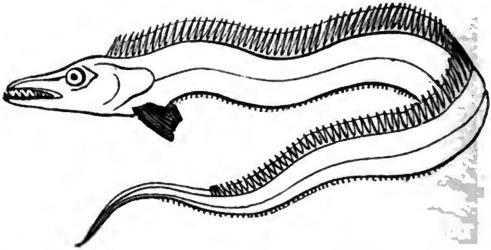
Lepidopus (Cuv.). *Scabbard-fish.* Body blade-like; head long, pointed; dorsal extending the whole length; anal moderately short; caudal forked; ventrals represented by two minute scales.

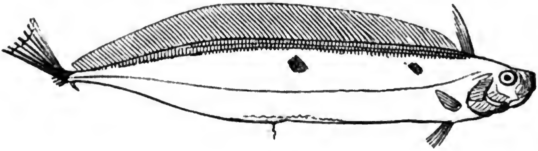
L. argyreus. Fig. 294; $\frac{1}{13}$ *n. s.*

Trichiurus (Linn.). *Hair-tail.* As *Lepidopus*, but ventrals, anal, and caudal are wholly wanting, the tail passing into a long fine point.

T. lepturus. Fig. 295; $\frac{1}{8}$ *n. s.*

295





296

Trachypterus (Cuv.). *Vaagmaer.* Body lengthened, blade-like; dorsal extending the whole length; ventrals delicate, long; pectorals small; anal wanting; caudal set on obliquely.

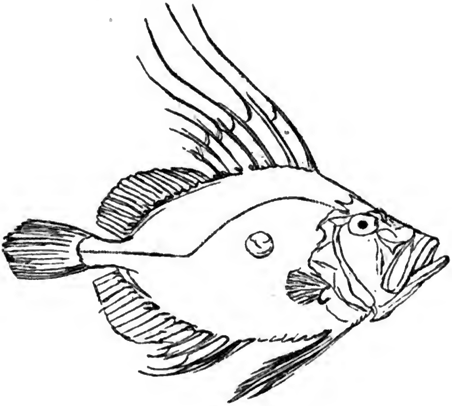
T. Bogmarus. Fig. 296; $\frac{1}{20}$ *n. s.*

FAMILY VII. SCOMBRIDÆ.

Body commonly ovate, often compressed; scales minute or invisible; fins strongly developed; pectorals usually long, narrow, and pointed; generally two dorsals, of which the first contains spinous rays, sometimes greatly lengthened; caudal generally forked.

Zeus (Linn.). *Dory.* Body short, greatly compressed, without scales; two dorsals scarcely separate, the first carrying long threads; mouth capable of great protrusion; a row of spinous scales on each side of the base of the dorsal and anal.

Z. faber. Fig. 297; $\frac{1}{5}$ *n. s.*



297

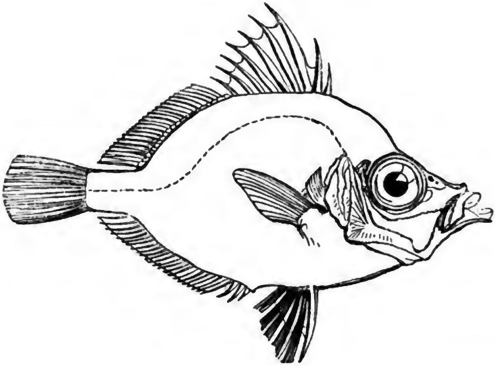
Capros (Lacep.). *Boar-fish.* As *Zeus*, but clothed with scales; no accessory threads to the dorsal, and no spines along its base.

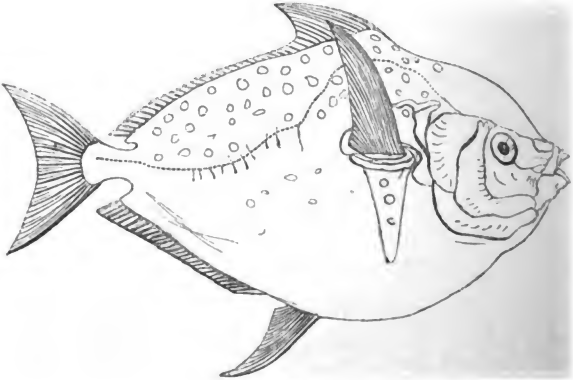
C. aper. Fig. 298; $\frac{1}{3}$ *n. s.*

Lampris (Cuv.). *Opah.* Body oval, compressed; one dorsal, much elevated and pointed in front; ventrals, pectorals, and lobes of the caudal long, curved, and pointed.

L. guttatus. Fig. 299; $\frac{1}{24}$ *n. s.*

298

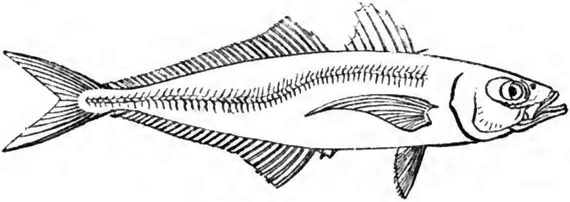




299

Caranx (Lacep.). *Scad.* Body scaled; lateral ine formed of broad keeled scales; two dorsals; ree spines in front of anal.

C. trachurus. Fig. 300; $\frac{1}{5}$ *n. s.*



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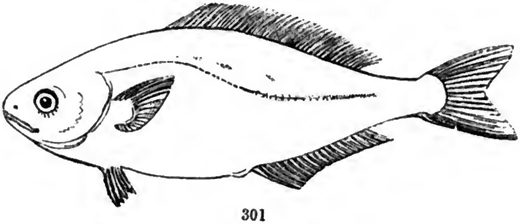

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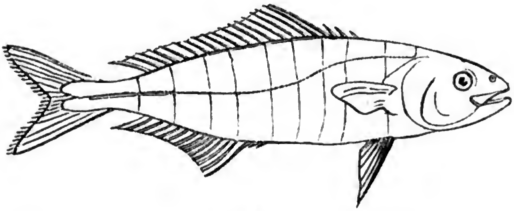


302

Centrolophus (Cuv.). *Black-fish.* Body covered with minute scales; one long, low dorsal.

C. pompilus. Fig. 301; $\frac{1}{10}$ *n. s.*

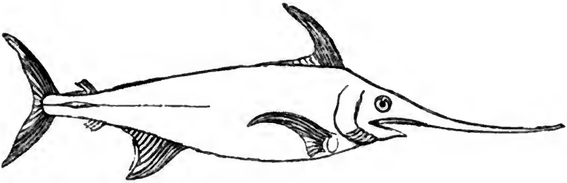
Naucrates (Cuv.). *Pilot-fish.* As in *Centrolophus*, but there are free spines before the dorsal and anal; sides of the tail keeled.

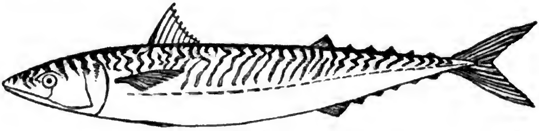
N. ductor. Fig. 302; $\frac{1}{4}$ *n. s.*

Xiphias (Linn.). *Sword-fish.* One dorsal very high in front; ventrals wanting; anal large; caudal high, and crescent-shaped; upper jaw prolonged into a hard sword-like beak.

X. gladius. Fig. 303; $\frac{1}{40}$ *n. s.*

303





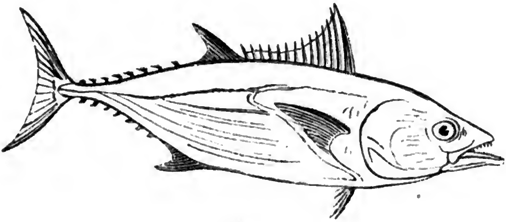
304

Scomber (Linn.). *Mackerel.* Body gracefully shaped, smooth, brilliant, clothed with minute scales; two dorsals remote from each other; second dorsal and anal cut into triangular finlets; tail crescent-shaped.

S. scombrus. Fig. 304; $\frac{1}{8}$ *n. s.*
colias.

Thynnus (Cuv.). *Tunny.* Large scales on the throat; first dorsal reaching nearly to the second; otherwise as *Scomber*.

T. vulgaris.
pelamys. Fig. 305; $\frac{1}{12}$ *n. s.*
sarda.



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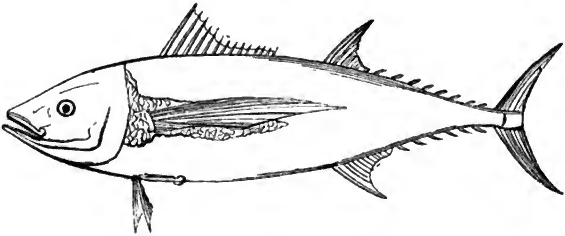

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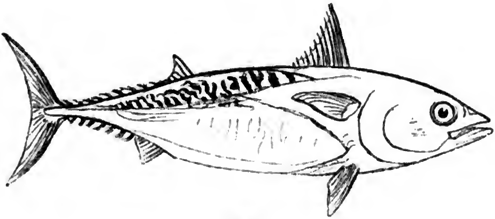


307

Ocynus (Cuv.). As *Thynnus*, but the pectorals very long, reaching beyond the vent.

O. alalonga. Fig. 306; $\frac{1}{6}$ *n. s.*

Auxis (Cuv.). Large scales on the breast as in *Thynnus*, but the dorsals remote as in *Scomber*.

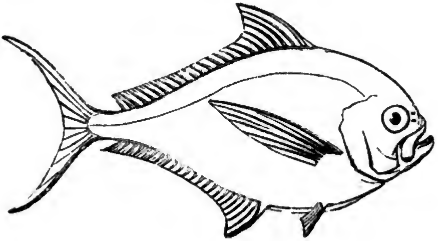
A. vulgaris. Fig. 307; $\frac{1}{6}$ *n. s.*

FAMILY VIII. CHÆTODONTIDÆ.

Body much compressed, very high; dorsal and anal fins clothed with scales.

Brama (Cuv.). Profile deep, abrupt; slender curved teeth in the jaws and palate; caudal high, narrow, crescent-shaped.

B. Raii. Fig. 308; $\frac{1}{10}$ *n. s.*
pinnasquamata.



308

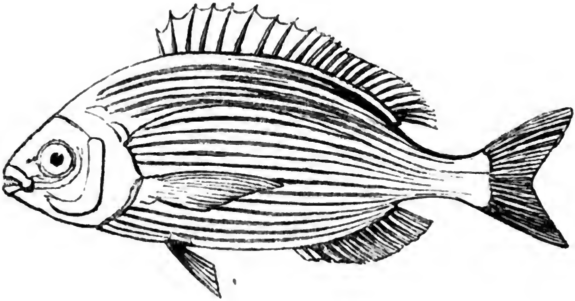
FAMILY IX. SPARIDÆ.

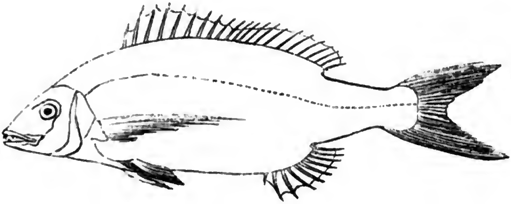
Body ovate, rather deeper than wide; a single dorsal, not scaled, falling into a groove on the back; gill-covers neither spinous nor notched; mouth not protrusile.

Cantharus (Cuv.). Teeth crowded, curved, placed like the prickles of a card round the jaws; mouth small.

C. griseus. Fig. 309; $\frac{1}{6}$ *n. s.*

309





310

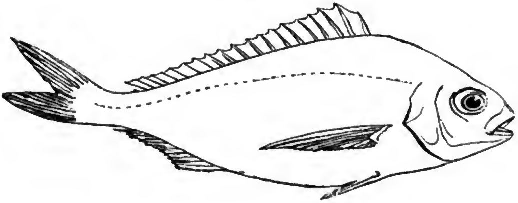
Dentex (Cuv.). Teeth conical, placed in a single row, the front ones larger, hooked inwards; a space beneath eyes and on muzzle free from scales.

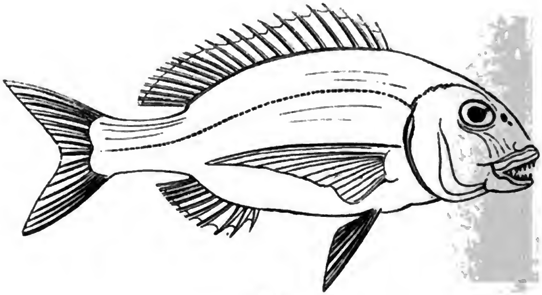
D. vulgaris. Fig. 310; $\frac{1}{8}$ *n. s.*

Pagellus (Cuv.). *Sea-bream.* Teeth in front conical, slender, numerous; sides of jaws set with flat molars like paving-stones, three rows above and two below.

P. erythrinus.
acarne.
centrodontus. Fig. 311; $\frac{1}{6}$ *n. s.*

311





312

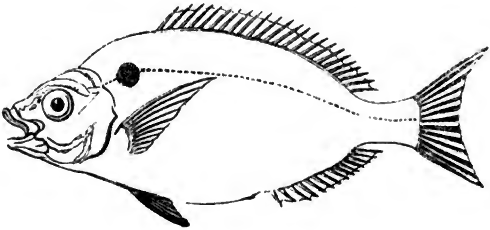
Pagrus (Cuv.). *Braize.* Four or six strong conical teeth in front, succeeded by small ones; two rows only of rounded molars in each jaw.

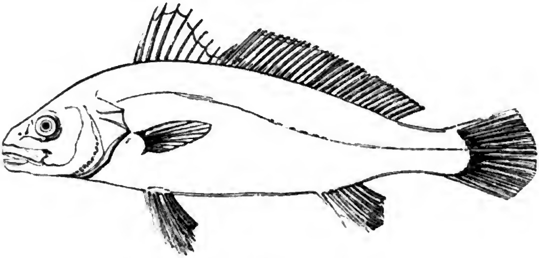
P. vulgaris. Fig. 312; $\frac{1}{4}$ *n. s.*

Chrysophrys (Cuv.). *Gilt-head.* Six conical teeth in each jaw in front; molars in four rows above and three below.

C. aurata. Fig. 313; $\frac{1}{4}$ *n. s.*

313





314

FAMILY X. SCIÆNADÆ.

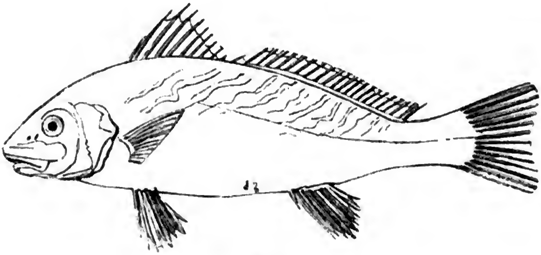
Body ovate, rather deep; dorsal grooved; gill-covers spined; fore gill-covers toothed; teeth in the jaws, but none in the vomer or palate; seven gill-rays.

Sciæna (Linn.). *Maigre.* Head inflated with cavernous bones; two dorsals; spines of the anal slender; head covered with scales; a row of strong teeth in each jaw.

S. aquila. Fig. 314; $\frac{1}{24}$ *n. s.*

Umbrina (Cuv.). As *Sciæna*, but the spines of the anal are stout and sharp; the teeth are small and numerous; and there is a filament on the chin.

U. cirrosa. Fig. 315; $\frac{1}{8}$ *n. s.*



315

Family XI. Trigladæ.

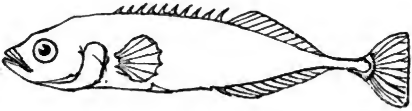
Head and face encased in a bony buckler of plates soldered together, often studded with spines; the bone beneath the eye (*sub-orbital*) greatly dilated, so as to cover the cheek, and jointed to the gill-cover; fins generally well developed.

Gasterosteus (Linn.). *Stickleback.* Without scales, but covered more or less with broad plates on the sides; one dorsal, with free spinous rays in front; ventrals (each consisting of a single spine) behind the pectorals.

G. trachurus.
  semiarmatus.
  leiurus.
  brachycentrus.
  pungitius. Fig. 316; *n. s.*
  spinachia.

Sebastes (Cuv.). *Norway Haddock.* Plates of the head scaled; one long dorsal, of which the first half is spinous; eyes very large; teeth small, numerous.

S. Norvegicus. Fig. 317; ¼ *n. s.*



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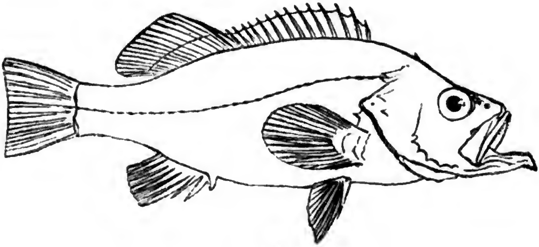

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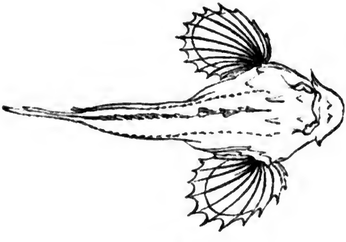


318

Cottus (Linn.). *Bull-head.* Head large, depressed; teeth in both jaws and in the vomer;

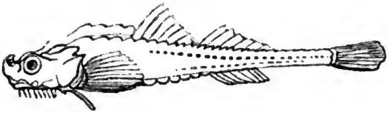
gill-covers spinous; gill-orifices large; gill-rays six; body slender, without scales; two dorsals.

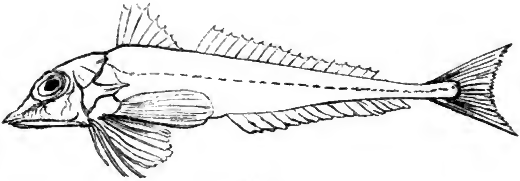
C. scorpius.
bubalis. Fig. 318; $\frac{1}{3}$ *n. s.*
quadricornis.

Aspidophorus (Cuv.). *Pogge.* Body eight-angled, enclosed in plates; recurved spines on the snout; teeth only on the jaws; lower jaw fringed.

A. cataphractus. Fig. 319; $\frac{1}{2}$ *n. s.*

319





320

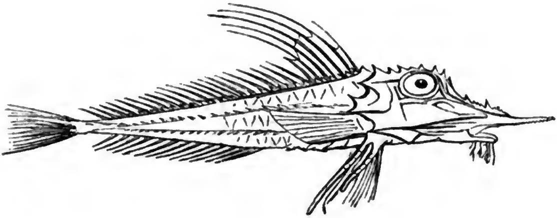
Trigla (Linn.). *Gurnard.* Head four-sided; sub-orbital plate very large; gill-cover and shoulder-plate ending in spines; three free rays beneath the pectorals; two dorsals; body clothed with small scales.

T. cuculus. Fig. 320; $\frac{1}{6}$ *n. s.*
lineata.
hirundo.
pæciloptera.

T. lyra.
gurnardus.
Blochii.
lucerna.

Peristedion (Cuv.). As *Trigla*, but the body is encased in hexagonal plates; and the snout runs out in two points; no teeth.

P. cataphracta. Fig. 321; $\frac{1}{6}$ *n. s.*



321

Family XII. Percadæ.

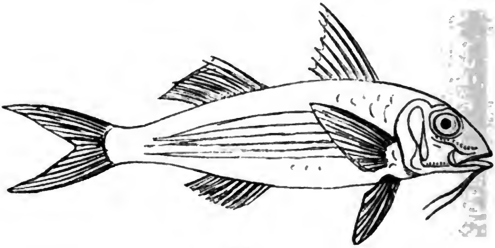
Body oblong, usually deep in the middle, clothed with rough scales; gill-covers armed with spines, or cut into teeth; both pairs of jaws, palate, and vomer set with teeth, which are usually minute and close like the pile of velvet; sub-orbitals connected with the temporal bones, and not with the gill-covers.

Mullus (Linn.). *Surmullet.* Head and fore parts thick; profile abrupt, nearly vertical; lower jaw carrying two filaments; gill-cover scaly, without spines; two dorsals.

M. surmuletus. Fig. 322; $\frac{1}{5}$ *n. s.*
barbatus.

Trachinus (Linn.). *Weever.* Compressed; eyes near together; mouth oblique; gill-cover ending in a strong spine; two dorsals, the first small, formidably spinous, the second long; anal equally long.

T. draco. Fig. 323; ¼ *n. s.*
vipera.



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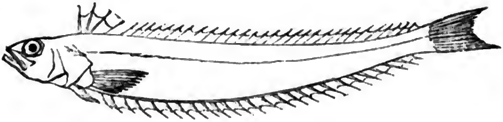

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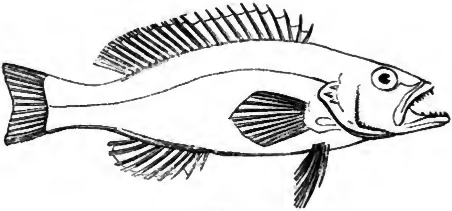


324

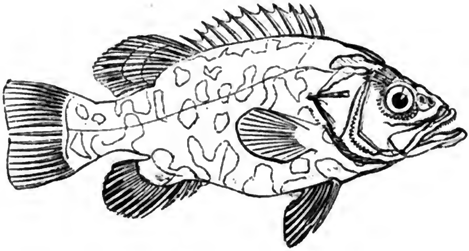
Serranus (Cuv.). *Sea Perch.* One long dorsal, of which the fore half is spinous; gill-covers and cheeks scaled; gill-cover ending in several flattened spines; fore gill-cover minutely notched; some long teeth among the small ones.

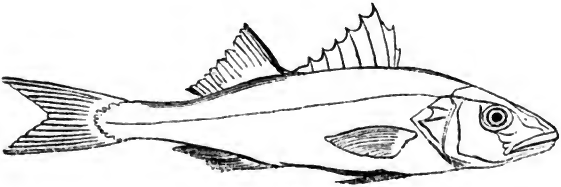
S. cabrilla. Fig. 324; $\frac{1}{4}$ *n. s.*
gigas.

Polyprion (Cuv.). Nearly as *Serranus*, but the gill-cover has a bony ridge ending in a single spine; its lower edge, as well as the fore gill-cover, the sub-orbital, and two arched ridges over the eye, are notched; the spinous rays of the dorsal, anal, and ventrals, are also notched along one edge.

P. cernium. Fig. 325; $\frac{1}{15}$ *n. s.*

325





326

Labrax (Cuv.). *Basse.* Two dorsals; teeth on the jaws, vomer, palate, and tongue; gill-cover ending in two spines; fore gill-cover notched.

L. lupus. Fig. 326; $\frac{1}{5}$ *n. s.*

CLASS V.* MAMMALIA.

(MAMMALS.)

THE peculiarity which is most distinctive of this Class,—the most exalted of all living creatures,—is that its members bring forth living young, which they suckle and thus nourish in the period of early infancy with a fluid secreted in the body of the mother.

The blood is warm, circulating in closed vessels; the whole quantity is sent from the heart to the *lungs*, a spongy mass of minute cells in the cavity of the body, communicating with the external air. Over the surface of these cells the blood-vessels ramify, their coats becoming so thin as to admit the union of the oxygen with the contained blood, the result of which is an instantaneous change of its colour from dark-red to vivid scarlet. This renewed blood is now returned by another set of vessels to the *heart*, whence it is ejected into the *arteries*, which, large at first, but branching with innumerable ramifications, convey it to every part of the body, at length transferring it through tubes (*capillaries*) of excessive minuteness into the *veins*. These now carry it back to the heart, whence it is again pumped, as it were, into the *lungs* again. The *heart* is thus composed of four chambers, two *auricles* and two *ventricles*, which receive the blood in the following succession:—

---

* Of the intervening Classes,—AMPHIBIA, REPTILIA, and AVES,—REPTILIA is the only one which includes marine species; and of these none can properly be considered as British.

Lungs.
Veins.
Left auricle.
Left ventricle.
Arteries.
Capillaries.
Veins.
Right auricle.
Right ventricle.
Arteries.
Lungs.

In general, the animals of this Class are furnished with two pairs of limbs, fitted for walking on the solid ground; but those which we have to notice are adapted for aquatic life, and hence their structure is modified with a view to this adaptation. The Seals, which possess the usual number of limbs, have them shortened, enveloped in skin, and so placed as to perform the office of fins rather than legs, as indeed they resemble in appearance those fish-like organs. But in the Whales, the fore limbs are still more decided fins, while the hinder extremities are wholly wanting, their place being supplied by a broad horizontal caudal-fin: many of the species are also furnished with a proper dorsal.

Notwithstanding this fish-like form, however, the Whales and Dolphins have no real affinity with FISHES, but are true MAMMALIA; bringing forth living young, nourishing them with milk, having warm blood, a perfect circulation, and breathing air by means of internal lungs.

Localities, &c.—The Seals are found on the wildest, most rocky, and least frequented coasts, especially those which are indented with caverns, to which these animals delight to resort, and in which they congregate. They may often be seen off the shore, in summer weather, playing in the sea. The various species of Whales and Dolphins are dwellers in the broad ocean, usually associating in herds, and approaching the shore only by accident; the smaller kinds frequently ascend our tidal rivers, and the Whales are not rarely seen to enter bays and harbours, especially on the northern and western shores, where they are sometimes stranded.

Identification.—The presence of hind limbs; their structure; the comparative size of the head; its prolongation into a snout; the presence of a dorsal; the number and arrangement of the teeth, —are the points which principally require notice in the determination of the species.

Authorities. — Professor Bell's "History of British Quadrupeds," M. Fred. Cuvier's "Historie Naturelle des Cétacées," and the volumes on SEALS and WHALES in Jardine's "Naturalist's Library," have afforded me materials for the following enumeration.

MAMMALIA.

Vertebrate animals having warm blood; breathing by means of lungs; bringing forth living young, which are suckled and nourished with milk.

Order CETACEA.

Form fish-like; skin naked; fore limbs short; bones of the hand concealed in a skinny fin without claws; hind limbs wanting; tail terminated by a broad cartilaginous fin, set on horizontally; windpipe opening at the summit of the head by one or two *blow-holes.*

Head enormously large.

Muzzle rounded; upper jaw fringed . *Balænadæ.*
Muzzle truncate; upper jaw simple . *Physeteridæ.*

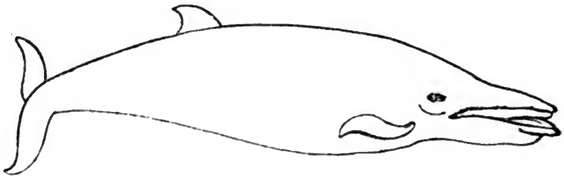
Head moderate . . . . *Delphinidæ.*

FAMILY I. BALÆNADÆ.

Head disproportionately large, with a sloping, rounded muzzle; upper jaws fringed with transverse plates of a horny substance (*whalebone*); both jaws destitute of teeth; blow-hole single.

Balænoptera (Lacep.) *Rorqual.* A small dorsal near the tail; throat and belly wrinkled with deep folds. (The largest of known animals.)

B. rostrata. Fig. 327; $\frac{1}{360}$ *n. s.*



327

Balæna (Linn.). *Right-whale.* No dorsal; belly smooth; whalebone very deep.

B. mysticetus. Fig. 328; $\frac{1}{240}$ *n. s.*

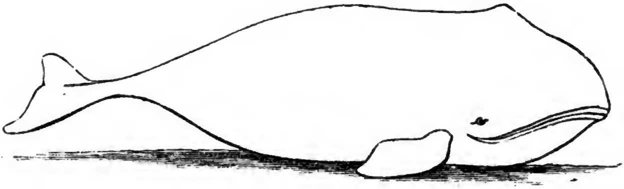
FAMILY II. PHYSETERIDÆ.

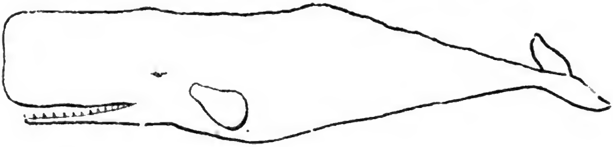
Head enormous, terminating in an abrupt, square muzzle; lower jaw narrow, pointed, armed with stout conical teeth; upper jaw destitute of teeth and whalebone; blow-hole single.

Physeter (Linn.). *Sperm-whale.* The only genus; characters those of the family.

P. macrocephalus. Fig. 329; $\frac{1}{250}$ *n. s.*
tursio.

328





329

FAMILY III. DELPHINIDÆ.

Head of moderate size, often prolonged into a beak; both jaws commonly furnished with teeth, which are numerous, and conical in form; no whalebone plates; blow-hole single, crescent-shaped.

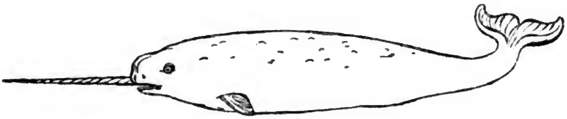
Monodon (Linn.). *Narwhal.* No teeth, except a pair of tusks in the upper jaw, only one of which is usually developed, projecting as a straight twisted ivory horn of great length ; no dorsal.

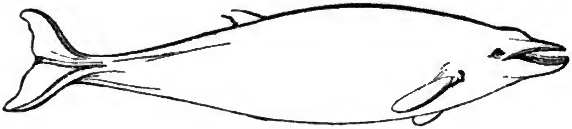
M. monoceros. Fig. 330 ; $\frac{1}{80}$ *n. s.*

Diodon (Less.). Two small teeth in front of the lower jaw, which is projecting and convex ; forehead low ; one dorsal.

D. Sowerbyi. Fig. 331 ; $\frac{1}{84}$ *n. s.*

330





331

Hyperoodon (Lacep.). *Bottle-nose.* Forehead high and round ; muzzle a short beak ; otherwise as *Diodon.*

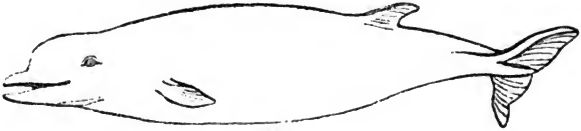
H. bidentatus. Fig. 332 ; $\frac{1}{80}$ *n. s.*

Beluga (Less.). *White Whale.* Head blunt, unbeaked ; nine teeth on each side in each jaw ; no dorsal.

B. leucas. Fig. 333 ; $\frac{1}{80}$ *n. s.*

Phocæna (Cuv.). *Porpoise.* Head blunt, unbeaked; teeth various in both jaws; a dorsal placed far back.

P. communis. Fig. 334; $\frac{1}{20}$ *n. s.*
orca.
melas.



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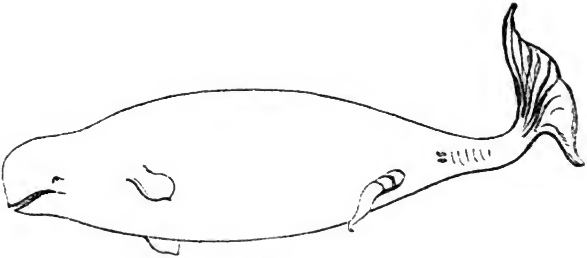

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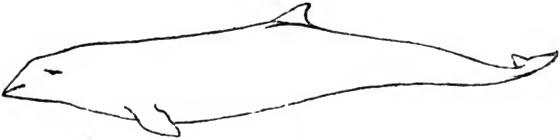


334

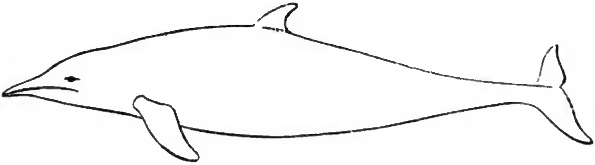
Delphinorhynchus (Blainv.). A lengthened beak, not separated from the forehead by a groove; a small dorsal.

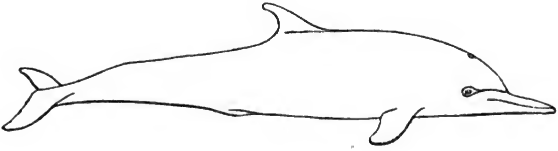
D. micropterus. Fig. 335; $\frac{1}{60}$ *n. s.*

Delphinus (Linn.). *Dolphin.* Forehead round; a lengthened slender beak, separated by a distinct groove; dorsal near the middle of the back.

D. delphis. Fig. 336; $\frac{1}{36}$ *n. s.*
tursio.

335





336

Order CARNIVORA.

Cutting-teeth (usually six) in front in each jaw; two stout pointed canines; and a varying number of molars, which have cutting edges.

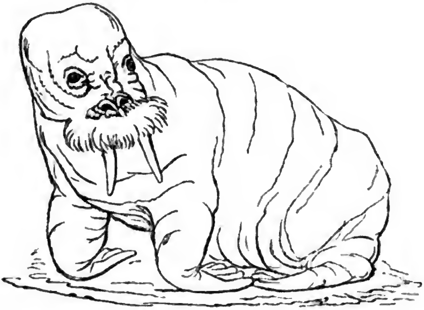
FAMILY PHOCADÆ.

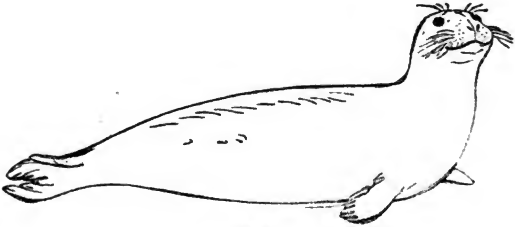
Fore limbs very short, enveloped in the skin, and reduced to swimming-paws; hind limbs set far behind, and directed backward; the toes connected by wide webs, forming powerful oars; body covered with dense short fur.

Trichechus (Linn.). *Walrus.* Lower jaw without cutting or canine teeth; canines of the upper jaw arching downwards, in the form of projecting tusks; muzzle greatly enlarged.

T. rosmarus. Fig. 337; $\frac{1}{40}$ *n. s.*

337





338

Halichœrus (Nilsson). Four cutting-teeth to each jaw; molars simple, the lower ones with a minute knob before and behind; head flat; muzzle deep, obliquely truncate.

H. gryphus. Fig. 338; $\frac{1}{16}$ *n. s.*

Phoca (Linn.). *Seal.* Six cutting-teeth above and four below; molars with a small cutting knob before the main one, and two behind; forehead round and full; countenance intelligent.

P. Grœnlandica. Fig. 339; $\frac{1}{40}$ *n. s.*
vitulina.
barbata ?
bicolor ?

339

ADDITIONS AND CORRECTIONS

TO

PART I.

Pp. 28, 29. *Actinia miniata* is a *Sagartia*, not a *Bunodes*.

P. 31. After *Edwardsia sphæroïdes*, add—

E. vestita.
  carnea.

P. 31. After line 12, add *Actiniadæ*, ot doubtful genera :—

A. coccinea.	See Johnston's Br. Zooph. 2d Edit.
intestinalis.	
biserialis.	
vermicularis.	
A. digitata.	Alder in litt.
A. tuberculata.	Cocks, in Trans. Royal Polyt. Soc. Cornwall.
Templetonii.	
Johnstoni.	
Ballii.	
Alderi.	
pellucida.	
Yarrellii.	
Bellii.	
Anthea Couchii.	
plumosa.	

P. 73. Add *Psolus tenema.*

P. 92. After *Flemingia plumosa*, add—

Crossostoma (Gosse). Upper margin of mouth set with cirri; segments thirty, the fore ones furnished with bristles, feet, and superior cirri; inferior cirri from the fourth segment to the tail, ear-like, cleft; eight tentacles on the second and third segments; tail furnished with a pair of minute styles.

C. Midas.

P. 94. After *Sabella chorœma*, add—

Protula (Grübe). Gill-fans two, each composed of four thick, soft, doubly-pectinate, radiating stems; their united base surrounded by a fleshy, reverted collar; body flat, divided into thorax and abdomen, composed of many segments; inhabiting a shelly tube, equally thick throughout, open at each end; many tubes crowded into a contorted mass, attached to submerged bodies.

P. Dysteri.

P. 103. After *Nereis versicolor*, add—

Crithida (Gosse). Antennæ five, very large, viz., a frontal pair, which are bulbous at base, and two-branched, and three occipital ones, which are very thick, tapering to a blunt point, and long; a pair of tentacular cirri on the head; two large eyes; feet ovate, very moveable, each with a thread-like cirrus above, a pencil of short bristles, and a second pencil of long straight bristles.

C. thalassina.

P. 133. After *Ione thoracicus,* add—

Pachybdella (Diesing). Body a three-sided sac, containing eggs arranged in bundles, like bunches of grapes; intestine passing straight through the body. Attached by the mouth to the abdomen of Crabs.

P. carcini. (See Ann. N. H. for Sept. 1855.)

P. 177. After *Halacarus ctenopus,* add—

Pachygnathus (Dugès). Palpi thick, conical, pointed; mandibles slender, style-shaped; limbs as in *Halacarus.*

P. notops.

P. 179. After line 19, add—

Order THYSANURA.

No wings; three pairs of legs; peculiar organs for locomotion at the sides or at the extremity of the body; no proper metamorphosis.

FAMILY PODURADÆ.

Feet jointed, fit for walking; body divided into head, thorax, and abdomen; breathing by air-pipes (*tracheæ*); two antennæ; mouth rudimentary; abdomen composed of six segments, usually ending in two bristles for leaping, bent under the body.

Anura (Gervais). Antennæ conical, shorter than the head, composed of four joints; four pairs of eyes; mouth without jaws, placed at the end of a conical proboscis; no scales; no leaping apparatus; no terminal points.

A. maritima.

Order DIPTERA.

One pair of membranous wings.

TRIBE NEMOCERA.

Antennæ many-jointed, much longer than the head; head small; body lengthened; eyes large; legs long and slender.

FAMILY TIPULADÆ.

Proboscis short; palpi curved downwards.

Clunio (Haliday). Proboscis obsolete; antennæ eleven-jointed, the third and eleventh joints long; wings not transparent, with two forked veins.

C. marinus.

P. 180 to be cancelled, and the following to be substituted for it:—

FAMILY I. HARPALIDÆ.

Wing-sheaths sessile, rounded at the tips; fore legs deeply notched.

Pogonus (Zeigl.). Fore feet (*tarsi*) with two dilated joints; thorax squarish; upper lip notched.

P. luridipennis.
chalceus.
littoralis.

Aepus (Leach). Head large, eyes minute, wing-sheaths flattened; upper jaws projecting, many-toothed.

A. marinus.
Robynii.

FAMILY II. BEMBIDIADÆ.

Last joint of feelers minute, conical.

Cillenus (Leach). Slender, flattened; third joint of antennæ longer than fourth; fourth joint of foot (*tarsus*) spined.

C. lateralis.

Bembidium (Illiger). Thorax heart-shaped, truncate; eyes extremely prominent; wing-sheaths rough.

B. concinnum.
scutellare.
ephippium.

TRIBE II. HYDROCANTHARI.

Legs formed for swimming; hind pair remote from second, fringed with hairs; body oval, depressed.

Hydroporus (Clairv.). Fore feet (*tarsi*) four-jointed; hind feet slender, with equal moveable claws.

H. inæqualipes.

TRIBE III. RYPOPHAGA.

One feeler to each maxilla; antennæ thickening towards the tips.

SUB-TRIBE I. PHILHYDRIDA.

Wing-sheaths covering abdomen; legs formed for swimming.

Heterocerus (Bosc). Body oval; leg-shanks spined; antennæ eleven-jointed, the last seven joints forming a club; feelers shorter than antennæ.

H. obsoletus.
femoralis.
pusillus.

Berosus (Leach). Antennæ eight-jointed, the last three forming a club; wing-sheaths prominent, much broader than the thorax.

B. spinosus.
luridus.

SUB-TRIBE II. BRACHELYTRA.

Wing-sheaths much shorter than abdomen; legs formed for running.

FAMILY I. OXYTELIDÆ.

Body slender; head projecting; fore-legs spinous; *tarsi* apparently three-jointed.

Phytosus (Rudd). Slightly convex; antennæ elbowed; thorax flattish, not channelled, spined at the front angles; legs downy.

P. spinifer.
nigriventris.

Bledius (Leach). Narrow, convex; fore legs toothed; antennæ elbowed; head and thorax (of male) horned.

B. tricornis.
arenarius.

Hesperophilus (Steph.). As *Bledius*, but head and thorax unarmed.

H. arenarius.

FAMILY II. OMALIADÆ.

Body broad and flat; head projecting; fore legs smooth; *tarsi* distinctly five-jointed.

Micralymma (Westw.). Oblong, flattened; wing-sheaths minute; abdomen long, much broader than thorax; margined; *tarsi* fringed with long hairs.

M. marina.

FAMILY III. TACHYPORIDÆ.

Head deeply sunk in the thorax; body short and thick; elytra comparatively large.

Diglossa (Haliday). Antennæ with the second joint very long; maxillæ with two very long lobes; lower lip with two long slender teeth.

D. mersa.

Homalota (Mann.). Slender, flat; thorax as broad as head; antennæ bead-like; last joint of *tarsi* long.

H. —— ?
—— ?

TRIBE IV. EUPODA.

Head and thorax narrower than abdomen; head sunk in the thorax to the eyes; hind thighs long and thick.

Hæmonia (Latr.). Antennæ with the fourth and fifth joints lengthened; wing-sheaths terminating in a minute point.

H. Curtisi.

P. 189. In the List of Illustrations, the numbers from 95 to 116*a* are false: 95 should be 94, and so on to 116*a*, which should be 116.

GLOSSARY

OF TECHNICAL TERMS IN PART II.

Arborescent (page 102). Resembling a tree.

Coalescent (p. 18). Closely adhering together.

Encrusting (p. 8). Spreading on solid substances like a crust.

Epidermis (p. 54). An outer skin.

Foliaceous (p. 12). Leaf-like.

Granulated (p. 80). Containing minute grains in its substance.

Immersed (p. 18). Sunk into the common substance.

Invertile (p. 18). Capable of turning inside out.

Laminated (p. 103). Furnished with thin leaf-like expansions (*laminæ*).

Medial (p. 8). Passing along the middle.

Papilla (p. 100). A soft fleshy wart.

Polyzoary (p. 7). The united mass of many *Polyzoa* organically connected.

Process (p. 103). A portion which *proceeds* or projects from the general outline, usually longer and more slender than a *lobe*.

Produced (p. 100). Drawn out.

Quincunx (p. 12). The arrangement of the knots in a net.

Serrated (p. 156). Notched like a saw.

Striated (p. 59). Marked with fine indented lines.

Thorax (p. 32). The part of the body answering to the chest.

Umbilicus (p. 118). The hollow axis of some Gastropod shells, around which the spire is wound.

Note.—For other technical terms refer to the Glossary in Part I.

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1.	TUBULIPORA patina (*nat. size*)	Specimen.
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3.	Idmonea atlantica (*n. s.* & *mag.*)	Ibid.
4.	Pustulipora proboscidea (*n. s.* & *mag.*)	Ibid.
5.	Alecto dilatans (*n. s.* & *mag.*)	Ibid.
6.	Crisia denticulata (*n. s.* & *mag.*)	Living specimen.
7.	Crisidia cornuta (*n. s.* & *mag.*)	Ibid.
8.	Salicornaria farciminoides (*n. s.* & *mag.*)	Specimen.
9.	Cellularia Peachii (*n. s.* & *mag.*)	Ibid.
10.	Menipea ternata (*n. s.* & *mag.*)	Ibid.
11.	Scrupocellaria scruposa (*n. s.* & *mag.*)	Ibid.
12.	Canda reptans (*n. s.* & *mag.*)	Ibid.
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14.	Salpingia Hassallii (*mag.*)	Coppin.
15.	Hippothoa divaricata (*n. s.* & *mag.*)	Specimen.
16.	Ætea anguinea (*n. s.* & *mag.*)	Living specimen.
17.	Beania mirabilis (*n. s.* & *mag.*)	Ibid.
18.	Gemellaria loricata (*n. s.* & *mag*)	Specimen.
19.	Notamia bursaria (*n. s.* & *mag.*)	Living specimen.
20.	Caberea Hookeri (*n. s.* & *mag.*)	Busk.
21.	Bicellaria ciliata (*n. s.* & *mag.*)	Living specimen.
22.	Bugula avicularia (*n. s.* & *mag.*)	Ibid.
23.	Flustra papyracea (*n. s.* & *mag.*)	Ibid.
24.	Carbasea papyrea (*n. s.* & *mag.*)	Specimen.
25.	Membranipora pilosa (*n. s.* & *mag.*)	Living specimen.
26.	Lepralia Pallasiana (*n. s.* & *mag.*)	Specimen.
27.	Cellepora pumicosa (*n. s.* & *mag.*)	Living specimen.

Fig.		
28.	Eschara foliacea (*n. s.* & *mag.*)	Specimen.
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31.	Cycloum papillosum (*n. s.* & *mag.*)	Hassall.
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33.	Amathia lendigera (*n. s.* & *mag.*)	Ibid.
34.	Vesicularia spinosa (*n. s.* & *mag.*)	Specimen.
35.	Valkeria cuscuta (*n. s.* & *mag.*)	Living specimen.
36.	Mimosella gracilis (*n. s.* & *mag.*)	Hincks.
37.	Avenella Dalyellii (*mag.*)	Thompson.
38.	Nolella stipata (*n. s.* & *mag.*)	Living specimen.
39.	Bowerbankia imbricata (*n. s.* & *mag.*)	Ibid.
40.	Farrella gigantea (*n. s.* & *mag.*)	Busk.
41.	Anguinella palmata (*mag.*)	Ibid.
42.	Pedicellina Belgica (*n. s.* & *mag.*)	Living specimen.
43.	Aplidium fallax (*n. s.* Forbes & H.) *mag.*	Savigny.
44.	Sidnyum turbinatum (*n. s.*)	Forbes & Hanley.
45.	Polyclinum aurantium (*n. s.*)	Ibid.
46.	Amœrœcium proliferum (*n. s.* & *mag.*)	Living specimen.
47.	Leptoclinum gelatinosum (*n. s.*)	Ibid.
48.	Distoma rubrum (*n. s.*)	Savigny.
49.	Botryllus polycyclus? (*n. s.*)	Living specimen.
50.	Botrylloides rubra? (*n. s.*)	Ibid.
51.	Syntethys Hebridicus (½ *n. s.*)	Forbes.
52.	Clavelina lepadiformis (*n. s.*)	Living specimen.
53.	Perophora Listeri (*n. s.* & *mag.*)	Ibid.
54.	Ascidia virginea (*n. s.*)	Ibid.
55.	Molgula tubulosa (*n. s.*)	Forbes & Hanley.
56.	Cynthia quadrangularis (*n. s.*)	Living specimen.
57.	Pelonæa corrugata (*n. s.* ?)	Forbes & Hanley.
58.	Salpa runcinata (*n. s.*)	Ibid.
59.	Appendicularia flagellum (*mag.*)	Huxley.
60.	Teredo norvegica (*n. s.*)	Forbes & Hanley.
61.	Xylophaga dorsalis (*n. s.*)	Ibid.
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64. Gastrochæna modiolina (*n. s.*) . . . . Specimen.
65. Saxicava rugosa (*n. s.*). . . . . Living specimen.
66. Pandora obtusa (*n. s.*) . . . . Specimen.
67. Lyonsia Norvegica (½ *n. s.*) . . . . . Ibid.
68. Thracia pubescens (⅓ *n. s.*) . . . . . Ibid.
69. Cochlodesma prætenue (*n. s.*) . . . . Ibid.
70. Panopæa Norvegica (½ *n. s.*) . . . . Ibid.
71. Poromya granulata (*n. s.*) . . . . Ibid.
72. Neæra cuspidata (*n. s.*) . . . . Ibid.
73. Corbula nucleus (*n. s.*) . . . . Ibid.
74. Sphænia Binghami (*n. s.*). . . . . . Ibid.
75. Mya truncata (½ *n. s.*) . . . . Ibid.
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77. Ceratisolen legumen (⅓ *n. s.*) . . . . Ibid.
78. Solen siliqua (⅓ *n. s.*) . . . . Living specimen.
79. Donax anatinus (½ *n. s.*) . . . . Specimen.
80. Ervilia castanea (*n. s.*) . . . . Ibid.
81. Scrobicularia piperata (½ *n. s.*) . . . . Ibid.
82. Syndosmya alba (*n. s.* & *hinge mag.*) . . Ibid.
83. Psammobia Ferroensis (½ *n. s.*) . . . . Ibid.
84. Diodonta fragilis (*n. s.*) . . . . Ibid.
85. Tellina incarnata (*n. s.*). . . . . Ibid.
86. Lutraria elliptica (¼ *n. s.*) . . . . . . Ibid.
87. Mactra stultorum (½ *n. s.*) . . . . . . Ibid.
88. Petricola lithophaga (*n. s.*) . . . . . . Ibid.
89. Venerupis irus (*n. s.*) . . . . Ibid.
90. Tapes pullastra (*n. s.*) . . . . Living specimen.
91. Lucinopsis undata (½ *n. s.*) . . . . . . Specimen.
92. Artemis exoleta (½ *n. s.*) . . . . Ibid.
93. Cytherea chione (⅓ *n. s.*) . . . . Ibid.
94. Venus verrucosa (*n. s.*) . . . . Living specimen.
95. Isocardia cor (⅓ *n. s.*) . . . . Specimen.
96. Astarte elliptica (*n. s.*) . . . . Ibid.
97. Circe minima (*n. s.*) . . . . Ibid.
98. Cyprina Islandica (¼ *n. s.*) . . . . . . Ibid.
99. Galeomma Turtoni (*n. s.*) . . . . Ibid.

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100.	Lepton squamosum (*n. s.*)	Ibid.
101.	Montacuta substriata (*mag.* $\frac{4}{1}$)	Specimen.
102.	Kellia suborbicularis (*n. s.*)	Ibid.
103.	Turtonia minuta (*mag.* $\frac{5}{1}$)	Ibid.
104.	Diplodonta rotundata (*n. s.*)	Ibid.
105.	Lucina spinifera ($\frac{1}{2}$ *n. s.*)	Ibid.
106.	Cardium echinatum ($\frac{2}{3}$ *n. s.*)	Ibid.
107.	Leda caudata (*n. s.*)	Ibid.
108.	Nucula nucleus (*n. s.*)	Ibid.
109.	Pectunculus glycimeris ($\frac{2}{3}$ *n. s.*)	Ibid.
110.	Arca lactea (*n. s.*)	Ibid.
111.	Modiola modiolus ($\frac{2}{3}$ *n. s.*)	Ibid.
112.	Crenella discors (*n. s.*)	Living specimen.
113.	Mytilus edulis ($\frac{1}{3}$ *n. s.*)	Ibid.
114.	Pinna pectinata ($\frac{1}{5}$ *n. s.*)	Specimen.
115.	Avicula tarentina ($\frac{1}{2}$ *n. s.*)	Ibid.
116.	Lima hians ($\frac{1}{2}$ *n. s.*)	Ibid.
117.	Pecten opercularis ($\frac{1}{2}$ *n. s.*)	Living specimen.
118.	Anomia ephippium ($\frac{1}{2}$ *n. s.*)	Ibid.
119.	Ostrea edulis ($\frac{1}{3}$ *n. s.*)	Specimen.
120.	Crania anomala (*mag.* $\frac{3}{1}$)	Ibid.
121.	Hypothyris psittacea (*n. s.*)	Ibid.
122.	Terebratula caput-serpentis (*n. s.*)	Ibid.
123.	Argiope cistellula (*mag.* $\frac{12}{1}$)	Woodward.
124.	Hyalea trispinosa (*n. s.*)	Specimen.
125.	Spirialis Flemingii (*mag.* $\frac{8}{1}$)	Ibid.
126.	Clio borealis (*n. s.*)	Gray.
127.	Elysia viridis (*n. s.*)	Woodward.
128.	Actæonia corrugata (*mag.* $\frac{5}{1}$)	Alder & Hancock.
129.	Cenia Cocksii (*mag.* $\frac{5}{1}$)	Living specimen.
130.	Limapontia nigra (*mag.* $\frac{6}{1}$)	Woodward.
131.	Eolis coronata (*n. s.*)	Living specimen.
132.	Fiona nobilis ($\frac{1}{2}$ *n. s.*)	Adams.
133.	Embletonia pulchra (*mag.* $\frac{4}{1}$)	Alder & Hancock.
134.	Proctonotus mucroniferus (*mag.* $\frac{2}{1}$)	Ibid.
135.	Antiopa cristata (*n. s.*)	Living specimen.

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136. Hermæa bifida (*n. s.*) . . . . Alder & Hancock.
137. Alderia modesta (*mag.* $\frac{2}{1}$) . . . . . . Woodward.
138. Tritonia lineata (*mag.* $\frac{2}{1}$) . . . . . . Alder & Hancock.
139. Scyllæa pelagica (*mag.* $\frac{2}{1}$) . . . . . . Cuvier.
140. Dendronotus arborescens (*n. s.*) . . . Alder & Hancock.
141. Doto coronata (*mag.* $\frac{2}{1}$) . . . . Ibid.
142. Lomanotus marmoratus (*mag.* $\frac{2}{1}$) . . Ibid.
143. Doris tuberculata (*n. s.*) . . . . Living specimen.
144. Gonoidoris castanea (*mag.* $\frac{2}{1}$) . . . . . Alder & Hancock.
145. Triopa clavigera (*n. s.*) . . . . Living specimen.
146. Ægirus punctilucens (*n. s.*) . . . . . . Ibid.
147. Thecacera pennigera (*mag.* $\frac{3}{1}$) . . . . . Adams.
148. Polycera ocellata (*n. s.*) . . . . Living specimen.
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157. Amphisphyra hyalina (*n. s.*) . . . . . Forbes & Hanley.
158. Cylichna cylindracea (*n. s.*) . . . . . Specimen.
159. Acera bullata (*n. s.*) . . . . Ibid.
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163. Dentalium entalis (*n. s.*) . . . . Specimen.
164. Patella vulgata (*n. s.*) . . . . Living specimen.
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166. Calyptræa Sinensis (*n. s.*) . . . . . . Ibid.
167. Pileopsis Hungaricus ($\frac{1}{2}$ *n. s.*) . . . . . Ibid.
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174. Phasianella pullus (*mag.* $\frac{3}{1}$) . . . . . Living specimen.
175. Trochus ziziphinus (*n. s.*) . . . . . . Ibid.
176. Adeorbis subcarinata (*mag.* $\frac{5}{1}$) . . . Specimen.
177. Littorina littorea (*n. s.*) . . . . . . Living specimen.
178. Lacuna vincta (*n. s.*) . . . . Ibid.
179. Rissoa parva (*mag.* $\frac{4}{1}$) . . . . Ibid.
180. Jeffreysia opalina (*mag.* $\frac{7}{1}$) . . . . . . Specimen.
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182. Truncatella Montagui (*n. s.*) . . . . . Specimen.
183. Scalaria communis (*n. s.*) . . . . . . Ibid.
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185. Aclis ascaris (*mag.* $\frac{4}{1}$) . . . . Ibid.
186. Turritella communis (*n. s.*) . . . . . . Living specimen.
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188. Cerithium reticulatum (*mag.* $\frac{3}{1}$) . . . . Living specimen.
189. Cerithiopsis tubercularis (*mag.* $\frac{3}{1}$) . . Specimen.
190. Stylina Turtoni (*mag.* $\frac{4}{1}$) . . . . . . Ibid.
191. Eulima polita (*n. s.*) . . . . Ibid.
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201. Marginella lævis (*n. s.*) . . . . Specimen.
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204. Nassa reticulata (*n. s.*) . . . . Ibid.
205. Buccinum undatum ($\frac{1}{3}$ *n. s.*) . . . . . Ibid.
206. Fusus Islandicus ($\frac{1}{2}$ *n. s.*) . . . . . . Specimen.
207. Trophon clathratus (*n. s.*) . . . . . . Ibid.

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219. Petromyzon marinus ($\frac{1}{8}$ *n. s.*) . . . . . Ibid.
220. Cephaloptera giorna ($\frac{1}{100}$ *n. s.*) . . . Müller & Henle.
221. Myliobatis aquila ($\frac{1}{8}$ *n. s.*) . . . . . . Specimen.
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223. Raia marginata ($\frac{1}{6}$ *n. s.*) . . . . Specimen.
224. Torpedo marmorata ($\frac{1}{8}$ *n. s.*) . . . . . Ibid.
225. Squatina angelus ($\frac{1}{10}$ *n. s.*) . . . . . Ibid.
226. Echinorhinus spinosus ($\frac{1}{30}$ *n. s.*) . . . . Bonaparte.
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232. Galeus vulgaris ($\frac{1}{24}$ *n. s.*) . . . . . . Specimen.
233. Notidanus griseus ($\frac{1}{20}$ *n. s.*) . . . . . Bonaparte.
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239. Acipenser latirostris ($\frac{1}{25}$ *n. s.*) . . . . Fresh specimen.
240. Balistes capriscus ($\frac{1}{4}$ *n. s.*) . . . . Yarrell.
241. Orthagoriscus mola ($\frac{1}{20}$ *n. s.*) . . . . . Ibid.
242. Tetraodon Pennantii ($\frac{1}{8}$ *n. s.*) . . . . . Donovan.
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250. Anguilla acutirostris ($\frac{1}{5}$ *n. s.*) . . . . Ibid.
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255. Solea vulgaris ($\frac{1}{4}$ *n. s.*) . . . . Fresh specimen.
256. Monochirus lingula ($\frac{1}{2}$ *n. s.*) . . . . . Ibid.
257. Rhombus punctatus (*n. s.*) . . . . . . Specimen.
258. Hippoglossus vulgaris ($\frac{1}{24}$ *n. s.*) . . . Donovan.
259. Platessa flesus ($\frac{1}{5}$ *n. s.*) . . . . Fresh specimen.
260. Raniceps trifurcatus ($\frac{1}{4}$ *n. s.*) . . . . Specimen.
261. Phycis furcatus ($\frac{1}{8}$ *n. s.*) . . . . Bloch.
262. Brosmius vulgaris ($\frac{1}{7}$ *n. s.*) . . . . . . Donovan.
263. Motella vulgaris ($\frac{1}{4}$ *n. s.*) . . . . . . Fresh specimen.
264. Lota molva ($\frac{1}{16}$ *n. s.*) . . . . Yarrell.
265. Merlucius vulgaris ($\frac{1}{15}$ *n. s.*) . . . . Donovan.
266. Merlangus vulgaris ($\frac{1}{5}$ *n. s.*) . . . . . Fresh specimen.
267. Morrhua lusca ($\frac{1}{5}$ *n. s.*) . . . . Ibid.
268. Clupea harengus ($\frac{1}{4}$ *n. s.*) . . . . . . Ibid.
269. Alosa finta ($\frac{1}{5}$ *n. s.*) . . . . Donovan.
270. Engraulis encrasicholus ($\frac{1}{2}$ *n. s.*) . . . Ibid.
271. Scopelus Humboldtii (*n. s.*). . . . . . Griffith.
272. Osmerus eperlanus ($\frac{1}{2}$ *n. s.*) . . . . . . Donovan.
273. Salmo trutta ($\frac{1}{6}$ *n. s.*) . . . . Fresh specimen.
274. Exocœtus exiliens ($\frac{1}{5}$ *n. s.*) . . . . . . Bloch.
275. Belone vulgaris ($\frac{1}{7}$ *n. s.*) . . . . Specimen.
276. Scomberesox saurus ($\frac{1}{5}$ *n. s.*) . . . . . Ibid.
277. Hemiramphus Europæus (*n. s.*) . . . Ibid.
278. Centriscus scolopax ($\frac{1}{2}$ *n. s.*) . . . . . Donovan.
279. Labrus Donovani ($\frac{1}{3}$ *n. s.*) . . . . . . Living specimen.

Fig.

280 Crenilabrus Norvegicus ($\frac{2}{3}$ *n. s.*) . . . . Living specimen.
281. Acantholabrus exoletus ($\frac{1}{2}$ *n. s.*) . . . . Yarrell.
282. Julis Mediterranea ($\frac{1}{3}$ *n. s.*) . . . . . . Donovan.
283. Lophius piscatorius ($\frac{1}{16}$ *n. s.*) . . . . . Living specimen.
284. Callionymus dracunculus ($\frac{1}{3}$ *n. s.*) . . Ibid.
285. Gobius Ruthensparri (*n. s.*) . . . . . . Ibid.
286. Blennius ocellaris ($\frac{2}{3}$ *n. s.*) . . . . . . Ibid.
287. Murænoides guttata ($\frac{1}{2}$ *n. s.*) . . . . . Ibid.
288. Zoarces viviparus ($\frac{1}{3}$ *n. s.*) . . . . . . Donovan.
289. Anarrhicas lupus ($\frac{1}{24}$ *n. s.*) . . . . . . Cuvier.
290. Mugil chelo ($\frac{1}{4}$ *n. s.*) . . . . Fresh specimen.
291. Atherina presbyter ($\frac{1}{2}$ *n. s.*) . . . . . Cuvier.
292. Cepola rubescens ($\frac{1}{4}$ *n. s.*) . . . . . . Donovan.
293. Gymnetrus Banksii ($\frac{1}{40}$ *n. s.*) . . . . . Hancock.
294. Lepidopus argyreus ($\frac{1}{13}$ *n. s.*) . . . . . Cuvier.
295. Trichiurus lepturus ($\frac{1}{8}$ *n. s.*) . . . . . Bloch.
296. Trachypterus Bogmarus ($\frac{1}{20}$ *n. s.*) . . Reinhardt.
297. Zeus faber ($\frac{1}{5}$ *n. s.*) . . . . Fresh specimen.
298. Capros aper ($\frac{1}{3}$ *n. s.*) . . . . Cuvier.
299. Lampris guttatus ($\frac{1}{24}$ *n. s.*) . . . . . Ibid.
300. Caranx trachurus ($\frac{1}{5}$ *n. s.*) . . . . . . Ibid.
301. Centrolophus pompilus ($\frac{1}{10}$ *n. s.*) . . . . Bonaparte.
302. Naucrates ductor ($\frac{1}{4}$ *n. s.*) . . . . . . Cuv. & Valenc.
303. Xiphias gladius ($\frac{1}{40}$ *n. s.*) . . . . . . Cuvier.
304. Scomber scombrus ($\frac{1}{6}$ *n. s.*) . . . . . . Fresh specimen.
305. Thynnus pelamys ($\frac{1}{12}$ *n. s.*) . . . . . . Cuvier.
306. Ocynus alalonga ($\frac{1}{6}$ *n. s.*) . . . . . . Newman.
307. Auxis vulgaris ($\frac{1}{8}$ *n. s.*) . . . . Cuvier.
308. Brama Raii ($\frac{1}{10}$ *n. s.*) . . . . Donovan.
309. Cantharus griseus ($\frac{1}{6}$ *n. s.*) . . . . . . Yarrell.
310. Dentex vulgaris ($\frac{1}{5}$ *n. s.*) . . . . Specimen.
311. Pagellus centrodontus ($\frac{1}{6}$ *n. s.*) . . . . Fresh specimen.
312. Pagrus vulgaris ($\frac{1}{7}$ *n. s.*) . . . . Cuv. & Valenc.
313. Chrysophrys aurata ($\frac{1}{4}$ *n. s.*) . . . . . Donovan.
314. Sciæna aquila ($\frac{1}{24}$ *n. s.*) . . . . Bonaparte.
315. Umbrina cirrosa ($\frac{1}{8}$ *n. s.*) . . . . Ibid.

Fig.		
316.	Gasterosteus pungitius (*n. s.*)	Living specimen.
317.	Sebastes Norvegicus ($\frac{1}{4}$ *n. s.*)	Cuv. & Valenc.
318.	Cottus bubalis ($\frac{1}{3}$ *n. s.*)	Living specimen.
319.	Aspidophorus cataphractus ($\frac{1}{2}$ *n. s.*)	Specimen.
320.	Trigla cuculus ($\frac{1}{6}$ *n. s.*)	Fresh specimen.
321.	Peristedion cataphracta ($\frac{1}{6}$ *n. s.*)	Cuvier.
322.	Mullus surmuletus ($\frac{1}{5}$ *n. s.*)	Ibid.
323.	Trachinus draco ($\frac{1}{4}$ *n. s.*)	Fresh specimen.
324.	Serranus cabrilla ($\frac{1}{4}$ *n. s.*)	Cuv. & Valenc.
325.	Polyprion cernium ($\frac{1}{15}$ *n. s.*)	Cuvier.
326.	Labrax lupus ($\frac{1}{5}$ *n. s.*)	Fresh specimen.
327.	Balænoptera rostrata ($\frac{1}{360}$ *n. s.*)	Scoresby.
328.	Balæna mysticetus ($\frac{1}{240}$ *n. s.*)	Cheever.
329.	Physeter macrocephalus ($\frac{1}{250}$ *n. s.*)	Beale.
330.	Monodon monoceros ($\frac{1}{60}$ *n. s.*)	Scoresby.
331.	Diodon Sowerbyi ($\frac{1}{64}$ *n. s.*)	Sowerby.
332.	Hyperoodon bidentatus ($\frac{1}{80}$ *n. s.*)	Hunter.
333.	Beluga leucas ($\frac{1}{80}$ *n. s.*)	Scoresby.
334.	Phocæna communis ($\frac{1}{20}$ *n. s.*)	Fresh specimen.
335.	Delphinorhynchus micropterus ($\frac{1}{60}$ *n. s.*)	Cuvier.
336.	Delphinus delphis ($\frac{1}{36}$ *n. s.*)	Living specimen.
337.	Trichechus rosmarus ($\frac{1}{40}$ *n. s.*)	Wolf.
338.	Halichœrus gryphus ($\frac{1}{45}$ *n. s.*)	Nilsson.
339.	Phoca Grœnlandica ($\frac{1}{40}$ *n. s.*)	Ibid.

ALPHABETICAL INDEX

TO THE GENERA AND SPECIES IN PART II.

N.B. The names of Genera *are printed in Italics; those of* species *in Roman.*

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